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THE BEGINNINGS OF HIGH-TENSION TRANSMISSION.

We are glad to be able to present in the current issue the first instalment of an account of the great system which has grown up in the Colorado mountains about a little plant for mining purposes which is notable as one of the very early applications of alternating current to energy transmission, and undoubtedly the earliest commercial power plant employing alternating current in this country. It involved in the beginning no startling innovation in voltage, and was not even in the early days of its initiation properly to be classed as a high-voltage system; but it was a courageous application of sound theory and advanced practice to the solution of the great problem of long-distance transmission, and the improvements once started at Telluride never stopped, thanks to the energy of the Messrs. Nunn. In point of fact, the energy transmission at the Gold King mine, which was the seed, so to speak, from which the whole great Telluride system has sprung, started as the result of desperate conditions that must be met somehow. The cost of fuel was prohibitively high, and, a water-power being available at a distance of somewhat less than 3 miles, it was determined to utilize this and furnish electric energy to save the situation at the Gold King mills. To this end, two of the largest lighting machines manufactured by the Westinghouse company, machines of a type which had then recently been installed at the falls of the Willamette, near Portland, Ore., were pressed into service, one as generator, the other as motor. They were practically the first large alternators built in this country with iron-clad armatures having replaceable armature coils. Of the pair installed for the original Telluride plant, the generator was provided with a composite field and the motor was self-excited by means of an auxiliary winding. The frequency was 10,000 alternations per minute and the motor voltage was 3000. The synchronous motor was brought to speed by a single phase Tesla starting motor—the pioneer of its tribe—in which the starting torque was so feeble that the armature had to be pushed over by hand and the load thrown on later; but the system, hurriedly gathered, as it was, and in a sense experimental, went from the very start with a success that did much to encourage the growth of energy transmission in this country.

The plant was actually first put into regular work in June, 1891, and its record for steady running in the next year was one which even for considerably later days would have been considered creditable. The aggregate time of shut-down due to electrical causes was less than forty-eight hours in nine months. The results, in fact, were so satisfactory that the plant was soon enlarged, following precisely the same system of synchronous transmission. The rapid development of polyphase apparatus, however, prevented any considerable enlargement in the line of synchronous transmis-

sion. Synchronous plants were put in operation during the next year or two at Bodie, Cal.; Walla Walla, Wash., and one or two other points, patterned in general after the Telluride plant, but they proved to be the last of their kind, although Telluride itself was only changed to the polyphase system in 1896. The voltage employed in the later synchronous installations was no higher than that at Telluride, although about a year later than the starting of the Gold King plant the first real step ahead was made in the 10,000-volt, 28-mile transmission for lighting purposes from San Antonio Canyon to San Bernardino, and even this modest voltage was reached only by using a bank of twenty oil-insulated transformers in series. These details of contemporary history are given merely to show how timid engineers were in the matter of high voltage and how much real nerve it took to break away from precedents and go in for an alternating-current transmission at a voltage looked upon as precariously high for a revolving armature. The instinct for experiment has been strong in the builders of the great Telluride system, and a far more important service to the art of energy transmission was done three or four years later at Telluride when the first large experiments with pressures from 30,000 to 60,000 volts, now standard in transmission practice, were there conducted.

Concerning the growth of the system from these small beginnings, he who runs may read. It now reaches into three states, has eight power stations with a capacity of more than 40,000 hp, and has some 600 miles of transmission lines. Its operating conditions, situated, as it is, largely in a wild and mountainous country with high altitudes and severe climate, have always been difficult, and not a little of the important work on protective devices and high-voltage insulation under extreme conditions has been carried out on its lines. In these matters it has been compelled to do pioneer work, as it has done from the beginning; and it is only just to say that this work has been singularly successful and the system has compared in steady and efficient operation very favorably with many another working under far less strenuous conditions. The science and art of high-tension transmission would be much poorer but for the persistent courage and steady hard work which have characterized the management of the Telluride Power Company since its first bold step, now more than twenty years ago.

MEASUREMENTS OF CORONA LOSS OVER AERIAL LINES.

Since working voltages of over 100 kilovolts have come into practical use on alternating-current transmission lines, the question of the limiting dielectric strength of atmospheric air has become of industrial, instead of merely scientific, importance. It is now well recognized that when a pair of parallel cylindrical wires are supported in air from poles, by means of high-tension insulators, no appreciable in-phase electric current passes between the wires, through the air, until the impressed potential difference attains a certain critical value. If, for instance, the wires have each a diameter of 1 cm, and are separated, say, 3 m apart, then there will be no appreciable current through the air between the wires and in time-phase with the impressed neutral voltage, until the latter is raised to about 50 kilovolts. This does not mean that absolutely no loss of energy occurs through the air below the critical voltage. It means that any such infra-critical voltage loss is so small as to be practically negligible, and also so small as to be hard to locate, because all insulators leak to some extent, and when very feeble leakage exists it is difficult to say whether all of it occurs at the insulator or whether most occurs at the insulator and a small portion through the air. As soon as the critical voltage has been passed, an in-phase component of current begins to develop, and energy begins to be dissipated in the air. The researches of Ryan, Mershon, Whitehead, Peek and others go to show that the loss does not begin uniformly all over the wires. It apears to start at small irregularities, or dirty points, on the surface. This is particularly noticeable when the wire is thick. Thin wires develop the energy-losing condition more promptly over their entire surfaces. A crackling sound begins to be heard emanating from the neighborhood of the wire, the odor of ozone may be detected, and a phosphorescent glow emanates from the wire, extending radially outwards to a distance depending on the supercritical voltage. This halo-like glow has given rise to the name of corona for all the associated phenomena.

The details of the process by which the energy is carried away from the wire in corona have not yet been made clear. There is, first, a direct leakage of electricity from the wire, the air particles in the neighborhood becoming individually charged at the expense of the wire, and then these charged particles are repelled or pushed away convectively, the charge being thus either carried off to the ground or dissipated in the atmosphere. Such dissipated electric charges at high voltage necessarily carry away electric energy. Secondly, as has been pointed out by Russell, substances affected by cathode rays, such as zinc oxide, phosphoresce in the presence of corona. This indicates that electromagnetic radiation is being developed in the corona. Moreover, the glow of the corona itself shows that radiation, detectible by the eye, is being produced within the coronal region—presumably by the secondary effects of violent molecular bombardment. But whatever may be the details of the mechanism producing the energy loss, it is certain that the loss may amount to many watts per running meter of wire.

A short paper by Messrs H. Görges, P. Weidig and A. Jaensch has recently appeared in the *Elektrotechnische Zeitschrift* giving the observed magnitudes of corona power-loss per kilometer of line, under various conditions of impressed voltage and separating distance. These curves, except near their lower ends, are approximately upbending parabolas. They, therefore, confirm the results given in the paper by F. W. Peek, Jr., read before the recent Chicago convention of the A. I. E. E., to the effect that the linear coronal power varies directly with the frequency, and with the square of the supercritical voltage. The effect at any one frequency, and any given geometrical disposition of wires, under assigned temperature and barometric conditions, is as though each wire had a definite leakage to ground; but that, instead of the entire impressed voltage developing power in this leak, only that portion of the entire voltage which is in excess of the critical value de-

velops such power. Thus, if the critical voltage for the assigned conditions happened to be 50 kilovolts and the impressed star voltage on each wire of a three-phase line was 60 kilovolts, then the power loss would be such as might occur in a ground leak of, say, 100,000 ohms to each kilometer of wire with 10 kilovolts working through it, that is, 1000 watts per wire-km. If, however, the impressed star voltage was raised to 80 kilovolts, the same 100,000 ohms leak on each kilometer would tap 30 kilovolts with a loss of 9000 watts per wire-km. The line loss thus increases rapidly as the impressed voltage rises above the critical value.

VISUAL ACUITY IN COLORED LIGHTS.

While it has already been established that monochromatic light increases acuity above the values found for light having an extended spectrum, there has been until now no satisfactory comparison of the visual acuity resulting from the use of monochromatic lights of different colors. In other words, the variation of visual acuity with the wave-length of monochromatic light has not been well established. Such experiments as have been made on this subject have been decidedly discordant in their results. Most of them have been carried on either with colored screens of somewhat uncertain character or with intensities far from the working values in practical use. The very interesting and valuable paper by Mr. Luckiesh elsewhere in these columns goes far to fill up this gap in our knowledge of physiological optics. What Mr. Luckiesh has done is to measure the visual acuity obtained with various pure spectral colors of equal photometric intensity. Furthermore, this intensity was well within the range of good practical illuminating values, and the acuity was tested with the admirable acuity target of Ives, which, while it does not correspond rigorously to reading acuity, is absolutely definable and extremely easy of adjustment over a very wide range, making it particularly satisfactory in such an investigation as this. Mr. Luckiesh apparently has taken great pains to eliminate sources of error, cutting out all questions of pupillary aperture by the use of a diaphragm, resting the eye and beginning observations at various parts of the spectrum to keep clear of difficulties due to varying adaptation, and eliminating the matter of accommodation by focusing sharply for each color investigated. Rather contrary to what one would have supposed, this last precaution seems to have been relatively unimportant within the range of colors employed, possibly owing to the fact that they were all comfortably within the range of accommodation of the investigator's eye.

The upshot of these studies has been to show that there is a material, though not very great, variation of the acuity with the wave-length of the monochromatic light employed. The most interesting feature of the results, however, is that this variation is not continuous in one direction. Acuity appears to have a well-defined maximum in the yellow and falls off when equally bright light of longer or shorter wave-length is used. In other words, at equal intensities it is the light of the highest intrinsic luminosity for the intensities used which seems to produce the sharpest definition. Lord Rayleigh's familiar theorem on the defining power of light of varying wave-lengths would call for an increase of acuity in linear relation to decreasing wave-length. In other words, if the eye be regarded simply from the standpoint of geometrical optics, one should see better by violet light than by green, yellow or red. Mr. Luckiesh's experiments show that with the eye as it is this relation does not hold. It seems quite unlikely that any experimental errors sufficient to cause this difference have affected Mr. Luckiesh's experiments, which seem to have been performed with singular care. Certainly, as he points out in the paper, no errors in the estimated photometric intensities are sufficient to account for the observed differences in acuity. To be sure, he used the equality-of-brightness method for comparing the intensities of colored lights, which always involves some little doubt; but as a photometrist of long experience he finds very close accordance between his own observations with the flicker photometer and with the equality-of-brightness instruments, so that he is justified in at least setting a limit beyond which this source of error cannot enter. Furthermore, the intensities of illumination used were within the range which has been shown by Ives to give good results with the equality-of-brightness comparisons. Beyond this, we may call attention to the fact that if such errors had entered they are not, according to ordinary experience, of a kind to result in showing an apparent maximum of acuity in the yellow or to account satisfactorily for the form of the acuity curve developed from Mr. Luckiesh's experiments.

The fact of the maximum of acuity in the yellow seems from this work to be established pretty conclusively, and the remaining question of scientific interest is why this should be the case in spite of the theoretically greater defining power of the short wave-lengths. In other words, why does the eye as a working organ display different qualities from those which one would ascribe to it regarded merely as a refracting system? The answer is probably to be found in the fact that Lord Rayleigh's theorem does not take into account errors in the refracting system, while the eye is notoriously very far from being a perfect optical instrument. In fact, it is an often quoted remark of von Helmholtz that if an instrument maker sent him an optical instrument as badly figured and corrected as the eye he would promptly return it. To discover the real bearing of the variation of the eye from a theoretically perfect instrument, on the variation of acuity with wave-length, will probably require a somewhat lengthy and intricate investigation, which we hope somebody will have the courage to undertake. As a mere suggestion for a possible direction of attack on this problem, it may be permissible to call attention to the possible effect of the chromatic difference of spherical aberration, which in a very short focus system uncorrected for color may have a very perceptible effect. It would be indeed an interesting fact in evolution if it should turn out that the eye had adjusted itself to give its best correction for spherical aberration in the yellow, which is the point of maximum luminosity on which vision chiefly depends. Speaking in broad terms, the refracting surfaces of the eye are not truly spherical, and neither is the retinal surface on which the rays are focused. All this, however, is merely a possible hypothesis to direct investigation. At all events, Mr. Luckiesh has done well in clearing up one of the outstanding problems in the theory of vision.

American Institute of Electrical Engineers Affairs.

At the regular monthly meeting of the board of directors of the American Institute of Electrical Engineers, held in New York on Friday afternoon, Nov. 10, it was voted to hold a smoker in the Institute rooms, on the tenth floor of the Engineers Building, after each monthly meeting, for the purpose of affording facilities for social intercourse among the members in attendance, and an appropriation not to exceed $50 per meeting was authorized for this purpose, beginning with the December meeting.

Forty-nine candidates for admission to the Institute as associates were elected, and 163 students were ordered enrolled. Upon recommendation of the sections committee a petition for authority to organize a branch at the Rose Polytechnic Institute, Terre Haute, Ind., was granted.

The special committee on the proposed Panama trip reported that the number of replies received from the membership to the preliminary circular was sufficient to justify undertaking the trip, and the committee further reported that, with the approval of the board, the date of departure from New York via steamer of the United Fruit Company will be Jan. 18, 1912, the steamer to arrive in New York on the return trip on Feb. 18. Another steamer will leave New Orleans on Jan. 20, arriving in New Orleans on the return trip on Feb. 6. The report was accepted and authority given to undertake the trip to the Isthmus under the conditions embodied in the report.

The invitation to the Institute of the National Waterways Commission of the United States Congress to take part in a hearing set for Nov. 21 on the development of water-powers was presented and considered, and was referred with instructions to the public policy committee.

A resolution was adopted citing that Mr. Edward D. Adams, to whom the Institute has in the past been indebted for many benefactions, has added to these a bronze bust of the distinguished physicist and mathematician Hermann von Helmholtz, which, in addition to testifying to the public spirit of the donor, carries with it associations of the friendly relations existing between the electrical engineers of Germany and those of America. The thanks of the Institute were tendered for the gift, and recognition was made of the influence of the work of von Helmholtz upon the practice of electrical engineering in America, the Institute expressing its deep appreciation of Mr. Adams' action in placing among its valued possessions the memorial of the German leader of scientific thought. The resolution also expressed appreciation of the courtesy of the Institute's sister society, the Verband Deutscher Elektrotechniker, of Berlin, in appointing and sending a representative to be present on the occasion of the presentation of the bust of von Helmholtz by Mr. Adams, which action was stated to be most happy because of giving opportunity for the recognition of the influence of von Helmholtz upon the practice of electrical engineering in the United States.

Upon invitation the president was authorized to appoint a representative upon the United States committee in connection with the proposed International Congress for the Prevention of Accidents and on Industrial Hygiene, in Milan, Italy, 1912.

An invitation to the Institute to join the eighth International Congress of Applied Chemistry, to be held in September, 1912, was accepted, and the president was authorized to appoint a representative of the Institute to attend the congress.

Upon recommendation of the code of ethics committee, the president was authorized to appoint an advisory committee to the committee, consisting of men prominent in the electrical profession.

A communication was read from Mr. Oberlin Smith, suggesting that the Institute have on record the photograph of each member and the details of his career. The secretary was instructed to express to Mr. Smith the thanks of the board for his suggestions, and the communication was referred to the board of examiners.

Presentation of Bust of von Helmholtz to American Institute of Electrical Engineers.

An interesting event in the recent history of the American Institute of Electrical Engineers was the presentation last week to that body of a bust of the great German scientist and teacher, Hermann von Helmholtz, the donor being Mr. Edward D. Adams, to whom the Institute is also indebted for generous gifts at various times to the Institute library, aggregating several thousand dollars, and for a bookplate which is one of the masterpieces of the late E. D. French. The bust is a reproduction in bronze of a marble original

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by Adolf Hildebrandt, completed for Helmholtz's seventieth birthday. Writing several years later and shortly before the death of Helmholtz, his daughter said: "Day by day he resembles more and more his bust, as if Hildebrandt had foreseen his future appearance in expression and carriage." The present copy is the only one which the Helmholtz family has permitted to be made.

President Gano Dunn in announcing the gift referred to the warm interest of Mr. Adams in the Institute and to his many notable gifts to the library during the period of its formation. To the degrees of Doctor of Laws and Master of Science with which he has been honored should be added, Mr. Dunn suggested, that of engineer-financier, as representing a double service which Mr. Adams had rendered to electrical engineering development. Mr. T. C. Martin, chairman of the historical and museum committee of the Institute, accepted the bust in appropriate terms, and in conclusion urged the desirability of members co-oper-

ating in the work of his committee in gathering, to hand down to posterity, in documents, in models, in relics, in vivid canvases and in animated busts, the records of these times and days which have done so much to produce great inventions and great men in the domain of electricity.

President Dunn then introduced Dr. Adolf Franke, of Berlin, director of the Allgemeine Electricitäts Gesellschaft, who had been commissioned by the Verband Deutscher Elektrotechniker to represent it on the occasion of the presentation of the bust, and who had been a student under Helmholtz. Dr. Franke extended the heartiest greetings from the members of the society which he represented, and said that the fact that American electrical engineers, who above all others have dealt with the largest problems of the industry in the last decade, are honoring Helmholtz shows that they fully realize that true science is at the foundation of their success. Referring to the period when he was a student under Helmholtz, he mentioned the vivid impressions received from the great scientist, and the mighty influence of his character and personality. His thoughts were so deep, his genius moved in such lofty heights, that it was sometimes difficult for the younger students to follow; but those who had already a knowledge of science received valuable inspiration from his teachings. Above all he had an intuitive insight into the principles common to different physical phenomena and a power of precise differentiation between theories of speculative character and actual laws. Referring to the original bust by Hildebrandt, Dr. Franke said that this was the result of a collection taken up by his friends and pupils in all corners of the world. The amount thus realized, however, was larger than was necessary for the specific purpose, and from the surplus provision was made for an etching of his head by Jacoby, and a medallion by Teutenhyn, a reproduction of which is awarded from time to time to prominent scientists.

President Dunn then called upon Mr. B. A. Behrend, who had also been a pupil under von Helmholtz. Mr. Behrend said that the bronze bust is an excellent likeness of the great master, at whose feet he had gained inspiration, both from his lips and from his personality. Helmholtz, he said, does not belong to any one narrow branch of science. "His genius enlightened with new creative thoughts the entire field of human knowledge. In medicine and in physiology, in mathematics and in physical science, in philosophy and in metaphysics, in each and all his genius was a beacon fire like that of Newton and of Darwin. We unite with the name of Newton our knowledge of the laws of motion; with the name of Darwin, our knowledge of the law of evolution and of natural selection; with the name of Helmholtz, our knowledge of the law of the conservation of energy. Loftiest and broadest of human minds, there stands the monumental intellectual figure of Helmholtz forever in the annals of science. There is no need to inscribe 'His Excellency' upon his tomb; the name he bore runs no more risk of oblivion than that of Galileo or that of Newton. Nor do we honor the master by this memorial; we are pleased to accept this monument from the hands of one who himself has been a great furtherer of the art of electrical engineering, for the advance of which this Institute was founded. The statue of Helmholtz will show future generations who pass this entrance hall the man whose example they must follow, if they wish to uphold the standard of science where he placed it. And to me, who have known the master, and who am the generous donor's friend, it is a pleasant privilege to be able to say these words on this occasion."

President Dunn then presented a resolution of thanks to Mr. Edward D. Adams, which was adopted with much enthusiasm. Although Mr. Adams had requested not to be called upon for remarks, he was compelled to defer to the insistence of the audience. Referring in his remarks to the course of progress of science, he said this differed from the progress of music, which had been from the equator to the northern countries. Science, on the other hand, has progressed from the East to the West, its course being from the Continent across England, to a lodging place here, where, through the activity of invention and research, and the audacity characteristic of our people, there is for it a future which in accomplishment we may hope has never been equaled in any of the countries of the older world. Referring to the development of electricity at Niagara, in which, as is well known the speaker played the leading part, he pointed out that at the time the plans were being prepared the alternating current figured most prominently as a means of executing criminals. In order to determine the market for electric power in the city of Buffalo, Mr. Edison, at the request of Mr. Adams, had a house-to-house canvass made, and reported that at least 50,000 hp could be used in that municipality and vicinity; Mr. Adams added that Mr. Edison so valued the chart of distribution and users which he had made that he declined a proposition of remuneration for his expenses in making the investigation, as he considered the record so valuable that he preferred to retain it as his own private property. Early in the Niagara investigations it was found that the state of the art was not adequately represented in print, and in order that the work at Niagara Falls should represent the most advanced state of the art as applied to industrial purposes, the services of leading scientists of the world were secured who formed the international "Niagara Commission." When the award of the first dynamo was given it was with the feeling that the design was in accord with the latest information, some of which had come by mail only a few days before. At no time since has there been any doubt as to the wisdom of the plans then adopted. The experience at that time taught the advantage of having the earliest information obtained from all sources, including information which may not appear in print for a year or several years. It was for this reason that in endowing a chair in Columbia University for physical research Mr. Adams provided in the deed of trust that the results of the researches made by scientists in different parts of the world should be promptly published and circulated.

Continuing, Mr. Adams remarked that the Niagara experience indicated that in industrial work those at the head are now much embarrassed in the employment of experts. It seems, he said, as though there had been a very great change since Lord Kelvin announced that an electrical engineer was nine-tenths mechanical and one-tenth electrical. Since then that statement has been modified by the growth of numerous specialties, and one is at a loss to conjecture how far the subdivision may proceed. It is estimated that the number of subdivisions of engineering to-day has reached more than 100. In many industrial applications for a single purpose it is often the case that four experts in that number of specialties must necessarily be consulted. While we find this subdivision in practical work satisfactory, we can certainly see the disadvantage that would result if we attempted to subdivide our common interest. Instead of there being subdivision there should be consolidation, at least in the sense that the Institute, while it has various departments representing the specialties of its membership, should seek the strength that comes from the aggregation of all the larger interests which its members represent.

President Dunn read communications received from the German Embassy in Washington and from the German Consul in New York, and also a congratulatory cablegram from the Verband Deutscher Elektrotechniker. A reply to the latter cablegram was sent as follows: "The American Institute of Electrical Engineers in meeting assembled sends heartiest greetings to the Verband Deutscher Elektrotechniker on the happy occasion of the visit of its delegate."

Rate Research for N. E. L. A.

The first meeting of the 1911-12 committee of the National Electric Light Association on rate research was held in the office of Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, in Cleveland, on Nov. 10. The members of the committee present were Mr. E. W. Lloyd, Chicago, chairman; Mr. L. H. Conklin, Scranton; Mr. R. S. Hale, Boston; Mr. J. D. Lyon, Cincinnati, and Mr. Doane. As guests of the committee Messrs. M. E. Turner, Cleveland; Mr. W. J. Norton, Chicago, and Mr. G. S. Merrill, Cleveland, were also present. The work to be done by the committee before the next annual convention was outlined, and it was decided to hold the next meeting on Dec. 8 at the New York headquarters of the N. E. L. A. The committee will be glad to have its attention directed to any systems of charging which are novel or of unusual interest. The chairman, Mr. Lloyd, is general contract agent of the Commonwealth Edison Company, 120 West Adams Street, Chicago.

New York Public Service Commission Forbids Charge for Date and Originating Address in Telegrams.

The New York Public Service Commission, Second District, has decided that a charge made by the Western Union Telegraph Company to the Postal Telegraph Cable Company for the words constituting the originating address and date upon a telegram transferred by the latter to the former company is unjust, unreasonable and unduly discriminatory, and the Western Union is required to desist from the practice. The Postal Telegraph Company complained to the commission, asking for an order restraining the Western Union from exacting a charge for the originating address and date of a telegram transferred from the Postal to the Western Union. The Western Union accepts transferred messages for transmission and delivery from the Postal to points not reached by the Postal, and charges the Postal its ordinary local rate for the transmission of the message from the point of transmission to the point of destination plus an additional charge for the name of the originating point and date. The name of the originating point and date usually constitute, under the rules in force for counting, four or five words. The commission's conclusions from the facts brought out at hearings are as follows:

(1) The rate scheme of both companies has been constructed on the basis that the proper charge for the transmission and delivery of the message where one company both receives and delivers is ascertained by the number of words in the message.

(2) The fact that the Western Union does not charge for the name of the originating point and date on transferred messages originating at non-competitive points shows that it does not make the charge for these matters on transferred messages originating at competitive points in order to compensate itself for the expense of transmitting the name of the originating point and the date.

(3) The Western Union does not in the case of a transferred message transmit any more words than it would in the case of a message originating at the point of transfer. In other words, a message originating at the point of transfer would contain the name of the originating point and the date, and this would be transmitted free. The transferred message contains the name of the originating point and date, but is not transmitted free in case the originating point is competitive.

(4) The Western Union, receiving a transferred message, does add certain words to it, four or five in number, but it makes no charge whatever for these words. To all messages both companies add certain words for their own convenience in counting and otherwise, but for such added words neither makes any charge. The words added by the Western Union to a transferred message, although four or five in number, need not for any practical purpose be more than two, while the name of the originating point and the date always consist of four words and sometimes of five.

(5) The Western Union by this method of charging for the name of the originating point and the date of transferred messages necessarily receives more for its services than it would in the case of a message originating with it at the transfer point.

The commission, in an opinion prepared by Chairman Stevens, says it is not possible to assign any reason for this distinction except the desire of the Western Union to suppress competition at competitive points. The Postal assigns reasons why it desires to conduct its business at competitive points by the use of transferred telegrams which are entirely satisfactory and legitimate from its point of view; it is obviously to the advantage of the Western Union, as is shown by the charge which it makes and by the notices which it sends out, to prevent competition of the Postal at these points. The opinion continues:

"The only question which the facts and the necessary conclusions therefrom seem to leave open to be determined by the commission is whether it is legitimate and reasonable for the Western Union to make this charge for the name of the originating point and the date because a telegram originates at a competitive point. Its own practice determines that in other cases it is not reasonable, and it seems to us that this practice determines the whole matter. Clearly a public-service corporation must extend precisely the same facilities to a competitor as it does to the entire world. It can make no distinction between those offering it business. It must charge them alike and serve them alike. If it is its practice to serve the immense majority of its business without a charge for the name of the originating point and the date, and it obtains its compensation for the service in fixing the rate for the words in the body of the message at such an amount as will afford it a proper remuneration for transmitting all the message contains, that rule must obtain the same with competitors as with ordinary individuals. No satisfactory reason has been offered in support of the rule."

The opinion further states that during the progress of the case the Western Union changed its position, and its later position expressly repudiates what it first admitted, that the charge is for the extra words which it adds to the message for its own convenience and purposes. The charge is a departure from its general and settled scale, and as such must have a satisfactory reason for its existence. The burden was upon the Western Union to justify the exception, and it has failed to do so.

Chicago Traction Situation.

By order of the United States Circuit Court Mr. Samuel Insull was appointed receiver of the Chicago & Oak Park Elevated Railway Company on Nov. 13. This road—the old Lake Street line, the first elevated railway in Chicago—has been operating at a loss for several years and piling up a deficit. When the Chicago Elevated Railways merger was formed the Metropolitan, South Side and Northwestern elevated-railway companies were taken into the organization, but the Chicago & Oak Park was left out, as the Northwestern company is said to own 51 per cent of its stock. The minority stockholders endeavored to dispose of their stock to the new management, but were told, apparently, that their holdings were only of nominal value. The receivership, made on the application of the Central Trust Company of New York, on a judgment for $133,551.

will enable the majority and minority stockholders to settle their differences in court. Mr. Insull, the receiver, is chairman of the executive committee of the Chicago Elevated Railways.

In the negotiations with the city relative to the unification of the elevated railways under a new ordinance one of the first steps will be a valuation of the properties. It is proposed that this be done by the existing subway commission, consisting of City Engineer John Ericson, Mr. E. C. Shankland and Mr. J. J. Reynolds, to whom may be added Mr. George Weston, the city's representative on the Board of Supervising Engineers, Chicago Traction. The latter board supervises the surface lines.

It is said to be Mayor Harrison's idea to create a fund by the operation of municipally owned subways, the revenue to be derived from an operating company or operating companies on lease. The fund so created may be used for the purchase of the surface and elevated railways, as ultimate municipal ownership of all street railways is said to be the Mayor's hope. However, the situation is complicated by moves dictated by political or private-business strategy, so that the ultimate outcome cannot now be foretold.

Battery Locomotives for Railroad Terminal Electrification.

An undercurrent of discussion among a group of the steam-railroad electrical engineers attending the convention of their body in Chicago recently turned on the possibility of battery-driven locomotives for the electrification of large railway terminals such as those of Chicago. It has been known that several railroad officials and manufacturers have been devoting much attention to this means of heavy traction, and evidence that a good deal has already been accomplished in these lines is afforded by the number of battery-driven electric cars already in use on branches of Western roads as "feeders." One engineer cited sixteen such battery-driven cars employing the new Edison nickel-iron battery as already in use out of twenty-two on order. Several of these cars, he said, have made 150 miles or more a day, with a freshening charge during the noon hour. The high charge rate of the nickel-iron battery has made it possible to put a large portion of the nominal full charge into these batteries in even the period of an hour. In several places where these battery-driven motor cars are used on branch-line feeders energy is purchased from local central-station plants where the cars lie over for the night. As the time of charging can be deferred until the morning hours of light load on the station, the electric companies have been able to make a low and profitable rate for this service. The battery-driven motor-car on auxiliary lines thus seems to have an important future significance for the small central station which has a low load-factor.

For terminal electrification, as in Chicago, where there is much interchange of cars between the many roads, an efficient and practical battery-driven locomotive, it was declared, would simplify the problem considerably. As was pointed out, such locomotives could use the present tracks without any changes in running conductors, third-rails or catenary trolleys, or any alterations in track signals, etc., and could interchange traffic without difficulty between roads and yards of different companies. To gain the same result with the usual means of electrification, some uniform standard of equipment would be required for all such roads entering into electrification.

A storage-battery locomotive and its tender laden with nickel-iron cells, it was estimated, would be about as large as the present steam locomotive and would be capable of pulling the ordinary 1000-ton train at a speed of 20 to 25 miles an hour over the 15 to 20 miles of electrified tracks making up the terminal electrification. While the locomotive itself would be shorter, the tender required to contain the battery, it was said, would probably approximate the size of a box car, although of only about the weight of the present coal-and-tank tenders. Such a battery tender might be dropped off when discharged and a fully recharged tender substituted, keeping the locomotive in continuous service while its tenders were being charged. On the straight tracks clear of switching complications third-rails or other conductors might be installed, relieving the demand on the battery and even aiding in recharging it. Such storage-battery locomotives would offer an excellent off-peak charging demand for large metropolitan generating systems from which energy could doubtless be purchased at a very low rate under these conditions. In case the railroads installed their own plants the battery-charging load would also prove of advantage in filling up the valleys between the peaks of the train-operation demands.

Railroad officials are watching the performance of battery-driven cars with great interest, but, as one prominent official declared at the Railway Electrical Engineers' banquet, are generally holding off from adopting any given system of electrification for the present in the fear that rapid improvements as yet only indicated will be made.

The Electric Vehicle in Boston.

Scientific collection and interpretation of operating data received special attention at the meetings of the Electric Vehicle Club of Boston on Nov. 1 and 8, 1911. Mr. B. C. Tiffany, of the Rausch & Lang Company, presided at the former gathering, and Mr. Day Baker, of the General Vehicle Company, Boston, was chairman at the latter, being elected permanent chairman of the club at the conclusion of the usual luncheon in the Edison Building. Mr. Fred M. Kimball, of Lynn, Mass., was a speaker at the earlier meeting and touched upon the importance of the engineering data sheet in the sale of electric vehicles. Mr. H. S. Baldwin, of Lynn, spoke briefly at the second meeting upon the engineering aspects of the problem.

It was announced that four new charging stations have been opened in Waltham, Natick, Sharon and West Somerville, Mass. Mr. L. D. Gibbs, of the Edison Electric Illuminating Company of Boston, stated that efforts are under way to secure a uniform system of accounting for electric-vehicle performance and expenditures, to be sanctioned by the Electric Vehicle Association of America, the Association of Edison Electric Illuminating Companies and the National Electric Light Association. A model electric garage is under consideration for the Commercial Motor Truck Show, which is to be held in Boston in March, 1912. Active efforts are being pushed to increase the usefulness of the electric pleasure vehicle in the Boston shopping district by seeking additional parking facilities from private parties owning land close to the public thoroughfares. On Nov. 8 it was stated that the American Express Company would shortly establish an electric garage in connection with its wagon repair shop in South Boston. On account of the high twenty-four-hour load-factor a low unit rate for energy will be obtained through the regular schedule of Edison prices. Plans are afoot for the holding of a banquet on behalf of the electric vehicle at the Boston City Club in December, to which the Governor of Massachusetts, the Mayor of Boston and various state and municipal officers will be invited. The program includes stereopticon and moving pictures of the latest electric-vehicle developments. Mr. E. S. Mansfield, Boston Edison company, was elected permanent vice-chairman of the club at the meeting of Nov. 8, and following the resignation of Mr. L. D. Gibbs as secretary Mr. Leavitt L. Edgar was elected to the latter office. The next meeting was scheduled to be held at the House of Edison Light, Newton Center, Mass., on Nov. 15.

Magnetic Properties of Iron at High Frequencies.

At a meeting of the American Institute of Electrical Engineers held in New York on Nov. 10 Mr. E. F. Alexanderson presented a paper entitled "Magnetic Properties of Iron at Frequencies Up to 200,000 Cycles per Second." The paper contained a record of tests of hysteresis and eddy-current losses and skin effect in iron strips. The iron core tested consisted of a ring 2 in. in diameter, made up of ten turns of soft iron strip 0.003 in. thick and 0.75 in. wide. The layers of the strip were separated by thin paper. The core was wound with twenty turns of silk-covered wire. The measurements were made by means of hot wire ammeters and voltmeters, use being made of certain condensers and induction coils adjusted to obtain proper time-phase relations between the voltage and the current.

The skin effect measurements consisted in determining the apparent permeability of the iron at various frequencies and densities, by observing the volts and amperes at the terminals of the test coil. It was found that the real permeability of the iron was the same at 200,000 cycles as at 60 cycles per second, although the apparent permeability was only about one-tenth as large at the high frequency as at the low frequency. The decrease of the apparent permeability was found to be substantially in agreement with the change that one would expect from purely theoretical considerations due to the skin effect, the penetration of the magnetism into the iron being only 0.003 cm at 200,000 cycles per second.

A series of designs of a 5-kw transformer for various frequencies from 60 cycles to 200,000 cycles per second was shown in tabular form. The 60-cycle transformer weighed 19.5 kilograms, had an efficiency of 90 per cent and a magnetizing current of 5 per cent. The 200,000-cycle transformer weighed 1.5 kilogram, had an efficiency of 98.3 per cent and a magnetizing current of 1.3 per cent. The calculations showed that the 200,000-cycle transformer has a low weight and is very efficient, whereas the 60-cycle transformer, built on the same proportions, is too inefficient to be acceptable, although it weighs twelve times as much as the 200,000-cycle unit. In spite of the skin effect the 200,000-cycle transformer has a magnetizing current of only 1.3 per cent, whereas if the core were removed the magnetizing current would be about 40 per cent.

The high-frequency current was obtained from an alternator of the same general type as the 100,000-cycle machine described by the author in a paper before the American Institute of Electrical Engineers in June, 1909. (See *Electrical World*, page 96, July 8, 1909, and page 223, July 22, 1911.) This alternator was designed primarily for the purpose of wireless telegraph and telephone service. In comparison with the earlier unit it has 800 instead of 600 slots, but it operates at only 20,000 r.p.m., which is the same speed as used with the lower frequency unit. The increase in frequency above the value indicated by the product of the number of armature slots and the speed is obtained by means of an armature winding of special type. The machine is constructed with 1200 magnetic (600 projections) poles in the field structure, and the 800 armature conductors along the face of the armature are interconnected in such a way that the effective voltage has a frequency corresponding to 1200 poles, although its value is reduced from what would be obtained if there were 1200 slots. The machine generates 90 volts at no load, as compared with 110 volts delivered by the earlier machine.

Discussion.

The discussion was opened by Dr. Harold Pender, who stated that certain tests made at the Massachusetts Institute of Technology, where a frequency of 200,000 cycles per second was obtained by the electric-arc method, confirmed the results obtained by Mr. Alexanderson, in that the actual permeability of the iron was found to be practically independent of the frequency. At the high frequency the apparent permeability was, of course, much reduced, but the true permeability, after proper allowance had been made for skin effect, was not altered.

Mr. B. A. Behrend stated that, although the efficiency of a 200,000-cycle transformer may be much higher than that of the low-frequency transformer, yet the high-frequency apparatus is useless for practical purposes, because of its lack of regulative properties.

Dr. C. P. Steinmetz remarked that it is very difficult from the mere number to realize what 200,000 cycles means. This frequency is forty times as high as the highest frequency at which sound is audible. Moreover, the oscillograph fails to give any readable indication at frequencies even lower than 5000 cycles per second. When using a current of 200,000 cycles electricity flows into the conductor in one direction at one point, while only 2000 ft. away the current flows in the opposite direction, and it is zero 1000 ft. distant. In wireless telegraphy it has been considered desirable to employ air-core transformers, not only on account of the assumed lessening in the core loss by use of air rather than iron, but by reason of the assumed lessened attenuation in the air core as compared with the iron-core transformer. The attenuation is attributable to the dissipation of energy in the transformer, and hence varies inversely with the efficiency. The results of the tests reported by Mr. Alexanderson showed that by using an iron core of proper proportions the efficiency is materially improved, and hence there should be a marked reduction in the attenuation of the waves used in wireless telegraphy. He stated that there should be a material advantage in wireless telegraphy in using iron-core transformers instead of the air-core apparatus employed at the present time.

Steam-Railroad Electrical Engineers at Chicago.

The Tuesday morning opening session of the fourth annual convention of the Association of Railway Electrical Engineers at the Hotel La Salle, Chicago, was reported in last week's issue. The convention continued in session until Friday noon, Nov. 10, when the election of officers for the coming year closed the meeting.

On Tuesday afternoon Mr. F. E. Hutchinson, of the Chicago, Rock Island & Pacific Railroad, presented the report of the committee on data and information, of which he was chairman. Among the subjects treated in this report were performance tests of a number of axle-lighting belts, statistics of railroad cars lighted by electricity, settings for stop-charge voltage cut-offs, cost of equipping locomotive electric headlights, temperature data on headlight glasses, and reports of efficiency and failures of electric-lighted trains. The committee's report was discussed briefly by Messrs. C. R. Gilman, Chicago, Milwaukee & St. Paul Railroad, and D. J. Cartwright, Lehigh Valley Railway.

VENTILATION.

A paper on the subject of "Ventilation," prepared by Mr. E. M. Cutting, of the Southern Pacific Railroad, chairman of the committee on ventilation, was read by title only, the committee being continued for another year with its personnel unchanged and asked to submit further data on ventilation subjects. Mr. Cutting's paper reviewed the various principles of ventilation, quoting largely from reports by Dr. W. A. Evans, of Chicago; Mr. William H. Lynch, of Chicago; Mr. Francis A. Bonner, and from a paper by Mr. S. G. Thompson on the Pennsylvania Railroads systems of car ventilation, read before the Western Railway Club. In conclusion, Mr. Cutting showed that the condition of offensiveness of air may be almost independent of its chemical purity, and vice versa.

In discussing the subject of ventilation Mr. W. H. Lynch,

ventilating engineer, Chicago, declared that, while the railroads want proper ventilation of their cars, no settled system or policy has yet been determined upon and the initiation of such ventilation will come in the nature of something new. Many special problems of ventilation will require the use of electric power, as exhaust fans and cooling fans. The air intake is of even more importance than the exhaust. In general it may be said that vitiated air rises, owing to its higher temperature, and the problem should be attacked with this principle in mind. Pure, individual air is as important as the individual drinking cup, asserted Mr. Lynch, adding that the solution of ventilation problems with the minimum of air will largely save heating.

Dr. W. A. Evans, former health commissioner of Chicago, was next called upon, and declared that in his estimation the problems of ventilation are already practically solved, being in essence the methods adopted by the Pennsylvania Railroad and the Master Car Builders' Association. Dr. Evans urged the use of "a thousand times as many agitation fans" as are now employed on cars, declaring that these fans should be run twelve months in the year, for comfort in summer, but for health in winter. The speaker also referred to the intake of air through car floors and the possible application of electric discharges to remove the dust from this air. In answer to a question he gave as his opinion that the average ozone machine produces but a negligible quantity of O_3, and that ozone in quantities might kill odors without destroying the dangerous bacteria.

TRAIN-LIGHTING STANDARDS.

On Wednesday morning the report of the committee on standards was read by Mr. D. J. Cartwright, of the Lehigh Valley Railway. The committee recommended the use of a uniform data label on all electric-lighted cars, the use of three-wire train lines for head-end system operation, and uniform arrangements of batteries, charging receptacles, fuses, car switchboards, axle generators, conduit construction, pulley seats, etc. A nominal pressure of 60 volts was recommended for straight storage and head-end systems, and 30 volts, nominal, for straight storage and axle dynamo systems. Cars furnished by a foreign road for operation in electrically lighted trains, it specified, should be equipped with permanent or temporary train-line circuits. Electrically lighted cars furnished to foreign roads should be paid for at the rate of 75 cents per car per day for the use of electric equipment. For repairs made to electrical equipment 35 cents per hour, and materials at cost, should be charged. In addition to Chairman Cartwright, the report was signed by Messrs. F. R. Frost, Atchison, Topeka & Santa Fé Railway; A. J. Collett, Union Pacific Railroad; J. R. Sloan, Pennsylvania Railroad; C. R. Gilman, Chicago, Milwaukee & St. Paul, and A. J. Farrelly, Chicago & Northwestern.

Mr. W. J. Bohan, of the Northern Pacific Railroad, referred to the expense of temporary train-line construction on axle-lighted cars to be operated on head-end-lighted trains. Mr. A. J. Farrelly, Chicago & Milwaukee Railroad, said that the only objection to installing generally such train lines, composed of three No. 4-0 wires, is the cost, and that no car should be tendered to a road operating head-end systems without train-line equipment. Mr. N. E. Lemon, of the Pullman company, declared that the present tendency is toward axle equipment, for which the only connector apparatus needed are the light car-to-car jumper connections. Injustice would be done to roads using axle-lighting systems if they were asked to install train lines throughout all their cars, of which only a small number are interchanged with head-end systems. Considerable discussion followed on the use of battery fuses. Mr. Lemon considered that fuses in this position were of no service, while Mr. Gilman pointed out that in case of fire or wreck the absence of such fuses might result in expensive legal charges. Mr. Cartwright spoke of the welding of an automatic switch when called upon to open the battery circuit. Others who took part in the discussion were Mr. Joseph Andreucetti, Chicago & Northwestern; Mr. J. R. Sloan, Pennsylvania Railroad; Mr. W. J. Bohan, Northern Pacific Railroad; Mr. H. G. Myers, Santa Fé; Mr. E. W. Jansen, Illinois Central Railroad; Mr. F. R. Frost and Mr. A. J. Collett, Union Pacific Railroad.

Mr. C. R. Gilman said that at least 60 volts is required for head-end systems on account of the transmission losses with lower potentials. The head-end system he declared to be the cheapest and most efficient form of operation. Mr. D. J. Cartwright reported that there are fifty-five roads having 5900 cars equipped with axle-light systems, while twelve other roads, operating 3685 cars, use the head-end system. Mr. W. J. Bohan, of the Northern Pacific, said that 70 per cent of the cars in use are equipped with 60-volt or 110-volt systems, including axle-lighting, straight-storage and head-end systems. Mr. W. L. Bliss, of the United States Light & Heating Company, was called on to compare the advantages of 30-volt and 60-volt operation. Thirty-volt lamps, he said, are in general sturdier, while the use of half the number of cells reduces the labor and trouble of cleaning and handling. Mr. A. J. Collett, Mr. J. R. Sloan, Mr. E. W. Jansen and Mr. N. E. Lemon also took part in the discussion.

The report of the committee on improvements was next read by Mr. Edward Wray, Chicago, and gave a brief description of improvements in car-lighting and railway electrical devices brought out during the past year by the manufacturers.

SHOP PRACTICE AND MOTOR DRIVE.

On Wednesday afternoon Mr. A. I. Totten, Chicago, read the report of the committee on shop practice, in the absence of Chairman C. J. Causland, chief electrician of the Pennsylvania Railroad. The report considered the comparative advantages of alternating and direct current for shop drive, from the standpoints both of generation and transmission and of motor application and speed control of the tool. Under some conditions it will be found advantageous to use alternating-curent generation and transmission, with direct-current motors, supplied through synchronous motor-generator sets, for driving special tools. The committee concluded that alternating current used exclusively should apply to the small division railroad repair shops, direct-current drive being preferably used in the larger installations. The report concluded with a warning against the increasing use of compressed air in railroad shops, and recommended the substitution of electric power for compressed air wherever possible, on account of the greater economy of motor drive.

Mr. A. J. Farrelly spoke of the superior flexibility of alternating-current systems, and cited an instance where shop plans were several times changed, requiring complicated direct-current equipment which could have been avoided by simply raising the transmission voltage had alternating current been originally used. Mr. F. E. Hutchison spoke of the need for adjustable-speed control for long and short tool cuts, and Mr. Totten referred to the use of multi-speed motors which give 25 per cent speed range. Mr. Farrelly insisted that the variable-speed feature of machine-tool drive is actually seldom used, and cited an instance in the Beech Grove shops of the Big Four Railroad at Indianapolis where two brothers working on a piece basis on similar machines, one driven by an alternating-current motor and the other by direct current, turned out approximately the same work in the same time.

MOLDED INSULATIONS.

An account of recent advances in the art of manufacturing electrical molded insulations was next given by Mr. Kurt R. Sternberg. The speaker described the electrical characteristics of hard rubber, and discussed the possibility of synthetic rubber prepared artificially, the first step in which process seems already accomplished by the isolation

of the material isophren. This has been formed from turpentine, but experiments are being prosecuted to produce a cheaper product from acetylene. Mr. Sternberg then described the insulation characteristics of porcelain, iron gummi, isolast, vulkanasbest, stabilit, tenacit, ambroin, eburin, galalith, pulvolit, rhadoonit, impregnated paper, presspan, leatheroid, pilit, gummon and sternoid. The latest important inventions in the insulation field, he said, are bakelite and condensite. Bakelite, the invention of Dr. L. H. Baekeland, has already been described in detail in the *Electrical World*. Condensite was produced by Mr. A. H. Aylsworth, of Glen Ridge, N. J., a former employee of the Edison laboratories. Condensite is a high-grade plastic which may be molded readily when uncured. The curing is done under heat and pressure, and the finished product is similar to polished hard rubber, although mechanically far stronger. It has high dielectric resistance, withstands most acids, is non-hydroscopic, resists heat and can be easily machined. It is odorless, resilient and very light in weight. Mr. Sternberg urged the use of a test piece of standard dimensions for conducting comparison tests on electrical insulations.

SHOP LIGHTING AND CAR ILLUMINATION.

Opening the session of Thursday morning, a paper entitled "The Light for Safety," by Mr. F. R. Fortune, Pittsburgh, Pa., was read by Mr. George C. Keech, of Chicago. Mr. Fortune's paper described the advantages of the Cooper Hewitt mercury-vapor lamp for shop and foundry lighting, and pointed out the advantages of monochromatic illumination. The author also showed that the large illuminated surface of the tube and its low specific intensity have advantages for shop lighting over brilliant light sources which may produce glare and other painful results.

Mr. A. J. Sweet objected to the conclusions drawn from the table showing the relative brilliancies of the tungsten filament and the mercury-vapor tube, since, he declared, properly arranged tungsten lighting installations protect the eye from the direct vision of the filament. In answer to a question by Mr. D. J. Cartwright concerning the use of mercury-vapor lamps in connection with other types, Mr. Keech said that while such lamps should not be low enough to interfere with vision they had been used at heights of only 8½ ft. from the floor in cases of machine shops.

Mr. L. S. Billew, of the Baltimore & Ohio Railway, next read the report of the committee on train-lighting practice, of which Mr. A. McGary, chief electrician of the New York Central, is chairman. This report described head-end practices on a number of railroads, advocating this system where large trains, unbroken, make continuous runs of at least ten hours' duration. The report recommended the employment of special train electricians, instead of the baggagemen, to maintain the electrical equipment at its best efficiency. In conclusion, details of axle-lighting practice were discussed, and a complete system of records and reports was advocated. Trouble was also reported from standard inclosed fuses, which have failed to indicate when blown, seem to open-circuit without cause and blow at improper current values. Mr. Farrelly said that in the operation of head-end systems on the Northwestern Railway service is furnished by the battery barely 3 per cent of the time, and on no account is it considered necessary to shut off the engine when the train is ascending heavy grades. Mr. Cartwright discussed the use of common or separate steam hose connections to carry the train-lighting and train-heating steam lines. Mr. A. J. Collett said that in the operation of his head-end systems he had found difficulty in getting the operating department to place the dynamo car next to the engine, in order that a good steam supply might be assured. Mr. C. R. Gilman, on the other hand, testified that his trouble had been in getting the dynamo car placed behind the mail cars, since the latter are usually built with blind ends and when the dynamo car is ahead the train electrician is prevented from passing through the coaches to supervise his lamps.

On Thursday afternoon Mr. Gilman presented the report of the committee on illumination. The report opened with a discussion of the eye and the terms and units of illuminating engineering, calculation of illumination, factor of glare, etc. Detailed suggestions followed for the lighting of railroad stations, station approaches, waiting-rooms, baggage-rooms, company offices, yards, shops, dining-rooms, lunch counters, train sheds, freight houses, etc. Types of lamps were next specified in detail, and data were given on the three-voltage rating for various types of carbon, tantalum and tungsten lamps. Mr. B. F. Fisher discussed the ability of modern tungsten lamps to withstand severe vibration, and illustrated how the more expensive high-efficiency units may offer the lowest renewal costs even in the case of low energy costs. Mr. Alexander McGary testified that the use of regulators had largely reduced lamp-replacement costs on the New York Central. Messrs. F. E. Hutchison, A. J. Collett and D. J. Cartwright also discussed illumination subjects.

ACCOUNTS AND REPORTS.

The report of the committee on accounts and reports was next read by Mr. F. R. Frost, its chairman. A sample statement was submitted for the accounting of car-lighting costs on a uniform schedule, so that comparison might be made between roads interested. The committee recommended rates of 5 per cent to cover each of the items of interest and depreciation. While the arrangement used, it was explained, is not in agreement with that of the Interstate Commerce Commission, the schedule was prepared primarily for the benefit of the train-lighting engineers. Mr. A. J. Collett pointed out that for this reason separate accounts should be kept by the regular clerical force and the engineer. Mr. D. J. Cartwright observed also that division should be made between repairs and renewals resulting from wrecks and those necessitated by ordinary service.

Thursday morning's session was opened with a paper by Mr. T. V. Buckwalter, of the Pennsylvania Railroad, Jersey City, N. J., on the subject of "Industrial Trucks for Railway Service." Motor-driven trucks have been used (1) to replace box cars in transferring freight between adjacent stations, (2) to replace horse-drawn vehicles, and (3) to replace and supplement manual labor. Mr. Buckwalter reported the saving accomplished by the Pennsylvania's electric baggage and mail trucks, and described the method of control, frame construction, controller and brake apparatus, battery equipment, etc. The average yearly cost of operation of the 2-ton trucks used in the Long Island yards is $475 a year, of which $40 is for energy, $100 for maintenance and repairs, $75 for depreciation of battery and $75 interest on the $1,250 investment.

In reply to questions, Mr. Buckwalter said that the freight trucks can be charged at 30 amp for five hours, sufficient to operate them eleven hours. The Pennsylvania terminal trucks, charged at 40 amp for four hours, receive enough energy for forty-eight hours' use. The baggage trucks make about 17 miles per day, while the freight trucks make 9 miles per day. Twenty-four-volt equipment is used, since this requires fewer battery cells and reduces the shocks due to careless starting and handling.

ELECTION OF OFFICERS.

The convention was brought to a close Friday morning with the election of officers. Mr. F. R. Frost, of the Atchison, Topeka & Santa Fé Railway, was unanimously elected president; Mr. D. J. Cartwright, Lehigh Valley, first vice-president; Mr. C. R. Gilman, Chicago, Milwaukee & St. Paul, second vice-president, and Mr. Joseph Andreucetti, Chicago & Northwestern Railroad, secretary. Messrs. L. S. Billew, Baltimore & Ohio Railway, and E. W. Jansen,

Illinois Central Railroad, were added to the executive committee, the other members of which are Messrs. A. J. Farrelly, H. C. Meloy, F. E. Hutchison and C. J. Causland. The place of the next semi-annual meeting was set for Atlantic City, N. J., the date preceding the convention of the Master Car Builders' Association. The next annual meeting will be at Chicago, at a date to be decided later. During a short business session at the close of the convention the constitution was amended so as to permit the transaction of business at all regular sessions, and the president was directed to appoint a committee on ball-bearing standards.

ENTERTAINMENT.

The entertainment features in connection with the Railway Electrical Engineers' convention began with an informal reception and dance in the Red Room of the La Salle Hotel, Monday evening. On Tuesday afternoon there was an automobile tour for the ladies, and on Wednesday afternoon a matinée party was given at a local theater. Wednesday evening the Car Lighting Club entertained the association at the La Salle Hotel, when Mrs. Morgan S. Woodward described her experiences during the siege of Pekin. The fourth annual banquet of the association, given by the Railway Electric Supply Manufacturers' Association, was held Thursday evening. Mr. Frederic P. Vose presided as toastmaster. Mr. W. L. Park, vice-president of the Illinois Central Railroad, and Mr. Frederic A. Delano, president of the Wabash Railroad, were the speakers. In referring to the possibility of electrification of railroads and railroad terminals, Mr. Park said that while the railroads realize the advantages of electrification they are disposed to wait until they are thoroughly convinced that the best method is obtainable. Mr. Delano said that he had observed with great interest the use of storage-battery cars now being applied for "feeder" service to steam roads, as well as the possibility of storage-battery locomotives for handling terminal service. While there are many advantages resulting from electrification, he frankly stated that the cost is yet too great for the railroads to consider.

Electric Welding.

At a meeting of the American Society of Mechanical Engineers held in New York on Nov. 14 the general subject of electric and autogenous welding was discussed in great detail. Mr. H. R. Cobleigh presented an introductory paper dealing with the general aspects of the subject, in which were described the origin and principles of each process and the apparatus used in each. He outlined the features of electric resistance welding, electric arc welding, thermit welding, oxy-acetylene welding and oxy-hydrogen welding. By means of numerous lantern slides the mechanical details of the apparatus employed in each system of welding were described. It was stated that each method possesses certain advantages and certain disadvantages, so that each system may be considered most advantageous for certain particular services.

Mr. G. E. Pelissier described the thermit process of welding, which depends upon the chemical combination of aluminum with oxide of iron, the resultant products being oxide of aluminum and iron. The chemical reaction takes place at a high temperature and leaves the iron in molten form, so that it may weld together metals between which the molten iron is allowed to cool. By the use of motion pictures the thermit welding of rails was shown in a striking manner.

Mr. C. B. Auel gave much interesting information relating to the Bernardos, Slavianoff and Zerener processes of electric welding. These processes differ according to the material used for electrodes. In the first-named process one electrode is formed by the metal to be welded, and the other electrode is of copper. In the second process the two metallic parts to be joined form the electrodes, while in the third process there are two carbon electrodes, with the metal forming an intermediate contact between these two electrodes. Much attention was devoted by the author to the Bernardos process, which he considered to be the most universally applicable. However, the Slavianoff process produces a stronger joint. In this process use is made of an arc of a length of about ¼ in., an emf of 25 volts and a current of 150 amp. In the Bernardos process the length of the arc would be about 1 in., the current from 160 amp to 700 amp, and the emf from 45 volts to 50 volts at the arc.

Mr. W. H. Brown described an electric welder acting according to the Zerener process, which he has found highly advantageous on account of the economy in operation, the consumption being 18 kw, as compared with 50 kw by other electrical processes.

The subject was further discussed by Messrs. W. H. Spire, J. D. Mooney, Henry Cave, W. R. Noxon, W. H. Lavin, W. J. Fritz, J. F. Springer, E. B. Katte and Dr. Lieber.

Some Electrical Aspects of the Signaling and Interlocking of a Great Railroad Terminal.

While modern railroad signaling and switch-operating mechanism is very largely dependent on electricity, the general subject of signaling and interlocking is one that appeals mainly to specialists and is not of direct interest to the main body of the readers of the *Electrical World*. Nevertheless, the important paper on "Signaling and Interlocking of the New Passenger Terminal of the Chicago & Northwestern Railway Company," read by Mr. J. A. Peabody, engineer of that company, before the Western Society of Engineers in Chicago on Sept. 20, is one that contains many facts of direct interest to electrical men, and what follows is a summary of some of the facts brought out in that comprehensive paper.

Inasmuch as the signaling and interlocking of a large railroad terminal are installed as much for the acceleration of traffic as for its protection, the means of receiving and giving information and of communication form a very important feature of the whole installation. This feature received attention from the designers of the new Chicago & Northwestern passenger terminal in Chicago. The various means of communication adopted in connection with various operations of train signaling, all of which require the use of electricity, are: Conductor-towerman-gateman system of annunciators, telautographs, various forms of automatic train annunciators and indicators, illuminated track diagrams, lamps over levers, telephones and "intercommunicating system."

The conductor-towerman-gateman system of communicating by lamp signals, whereby towermen, gatemen and conductors signal to one another at the time of the starting of trains, has been described briefly in this journal (*Electrical World*, Aug. 26, 1911, page 488). By means of this system the conductor in charge of the outgoing train, the gateman admitting passengers to the train platform and the tower director in charge of the interlocking signals are placed in communication with one another at the time of departure of the train by lamp signals operated electrically by push-button switches.

For the giving of information to all employees who should know about the probable and actual arrival of trains Gray telautographs were adopted. A single system of three transmitters and nineteen receivers was installed. The transmitters are placed in each of the two division dispatchers' offices and in the Lake Street interlocking tower. The receivers are placed in the office of the superintendent of passenger terminals, on the caller's balcony and in various other locations. A telephone has been installed

with each telautograph receiver and connected to a telephone switchboard in the Lake Street tower. A number of other telephones are connected to this board, the number of stations being eighty-four. In addition, provision is made for the connection of portable telephones at each of the principal manholes and junction boxes throughout the signaling plant.

In addition to annunciators indicating the approach of trains to towermen and indicators for protector circuits, illuminated track diagrams have been placed in the Lake Street and Clinton Street interlocking towers. The front of these diagrams is made of ground-wire glass, and on it the tracks, signals, switches, etc., are indicated. Behind the glass face are small tin boxes, each containing a 4-watt, 14-volt lamp. By this means the light from each lamp is confined to a particular area of the diagram. The lamps are controlled in such a manner that when there are no trains in the plant the entire track layout is illuminated. But, as a train passes through the plant, its progress is shown clearly by the lamps going out as the train occupies the different track circuits, the light reappearing behind the train as the latter leaves the track circuits. The route lined up through each track switch is indicated by means of the lamps through circuit-breakers on the switch levers. The information is shown so clearly and completely by the illuminated diagram that it is possible at night and on stormy days to operate the terminal train movements without the towerman seeing the trains.

For giving information from one tower to another relating to train movements a push-button scheme has been developed and named the "intercommunicating system."

The track circuits for the interlocking plants are supplied by means of loops from 20-volt storage batteries in the towers. For the train-shed track circuits two motor-generator sets converting the 110-volt direct current from the main power-house lighting mains into 20-volt direct current were installed in a relay room under the station platform. These feed direct to the tracks, the sets being run successively in six-hour periods. By using these machines instead of a rheostat the main lighting circuits and the track circuits are kept separate and a ground on one system will not affect the other.

Electrical energy for signaling and interlocking purposes is obtained from the terminal power house, previously described in the *Electrical World* (Aug. 19, 1911, page 435). Except for the Lake Street tower, which is adjacent to the main power house, alternating current is transmitted at 6600 volts, three-phase, for the signaling plant. The wires are laid in conduits. The energy is transformed to 220 volts, three-phase, for motors and to 220 volts and 110 volts, single-phase, for lighting. All transformers are of the subway type.

In order to show the varied character of electrical currents required for signaling at the Chicago & Northwestern terminal Mr. Peabody gives the following list:

6600-volt alternating current	Three-phase power transmission.
220-volt alternating current	Three-phase power secondaries.
220-110-volt alternating current	Three-wire tower lighting.
110-volt alternating current	Signal lighting.
55-volt alternating current	Locks on switch levers and lamps on levers.
14-12-10-volt alternating current	Lamps on illuminated diagrams.
220-110-volt direct current	Three-wire tower lighting.
110-volt direct current	Interlocking machines.
110-volt direct current	Telautographs.
20-volt direct current	Auxiliary circuits, emergency lever locks, telephone system, intercommunicating system.
16-volt direct current	Automatic signals.
12-volt direct current	Track circuit loop.
1-volt direct current	Individual track circuits.

Some statistics of the elaborate signaling equipment of the Chicago & Northwestern terminal may be of interest. There are in use in the signaling plant 553 electric motors, of which 235 are 1/6-hp signal motors and 288 are 1-hp track-switch motors; in addition, there are thirty motor-generators. Included in the installation are 531 cells of storage battery, 3056 incandescent lamps, twenty-six transformers, 1024 relays and 2,826,485 ft. of insulated wire.

Decision of the New York Commission in Queens Borough Case.

One of the most important cases decided by the New York Public Service Commission, First District, came before that body on an informal proceeding affecting the Queens Borough Gas & Electric Company. When the case was first brought before the commission the company stated that it had reduced its rates as rapidly as it could afford to do, and showed that in 1902 the rates for gas were a maximum of $1.80 per 1000 cu. ft. and a minimum of $1.60. These rates were reduced gradually to the figures of $1.30 maximum and $1.25 minimum, prevailing at the time the complaints were made. The rates for electricity from 1902 to Nov. 1, 1906, were a maximum of 20 cents per kw-hour and a minimum of 4.8 cents per kw-hour. These were reduced to the figures prevailing at the time of the complaint, 15 cents maximum per kw-hour and 3.5 cents minimum per kw-hour. The company offered to continue the reductions and to make the rates for general consumption in 1911 $1.25 for gas and 14 cents for electricity, and also to reduce the rates still further if the finances would warrant. The proposal was not approved and the case was allowed to proceed. The final decision was that the maximum rate for gas should be $1.20 per 1000 cu. ft. from July 1, 1911, to Jan. 1, 1912, and $1.15 per 1000 cu. ft. from the latter date to July 1, 1912, and that the maximum rate for electricity should be 13 cents per kw-hour from July 1, 1911, to July 1, 1912.

An appraisal of the physical property was made, which gave for the gas department $707,815 and for the electrical department $637,724, or a total of $1,345,539. In addition an allowance was made for engineering, supervision, contingencies, incidentals and a general contractor's profit of $136,345 for the gas department and $126,608 for the electrical department, or a total of $262,953. The company had asked for an allowance of 25 per cent upon every item in the net physical cost, amounting to a total of $336,000. It was held that if a general contract was let for the reproduction of the plant and overhead charges were figured at the usual rate, the total cost would probably be less than that given above. The allowance is based in part on piecemeal construction, and consequently the unit prices adopted are larger than a general contractor would charge.

The company has recently acquired for $21,000 two parcels of land which are not being used nor urgently needed for immediate use. This purchase was justified by the company on the ground that land in the vicinity is increasing steadily in value, and that it would be cheaper to purchase now than to wait and pay much higher prices when more land is actually needed. The commission held that until this new land is used for gas or electrical purposes and is necessary for efficient and economical management it should not be included as a necessary part of the property upon which the company is entitled to earn a fair return.

The commission held that the estimate of $130,000 for preliminary and development expenses is ample for all items except interest and taxes during construction, and that it would not be unfair to compute interest and taxes upon one-half reproduction cost plus the cost of land and other preliminary and development expenses. Upon this basis an allowance of $90,000 was made. For working capital an allowance was made of $30,000 for the gas department and $45,000 for the electrical department.

A representative of the company asked that in addition to the factors produced there should be added some considerable sum for "going concern" on the grounds (1) that the property has been adjusted, tried out and unified; (2) that the company has a clientèle, established connections and a name in the community; (3) that valuable experience and data regarding the business have been accumulated; (4) that the early years wherein losses usually occur

have been passed. Taking up these points, the commission held (1) that the fact to be kept in mind is that the present case is a rate case, and that a fair value for condemnation is not necessarily a fair value for rate making; (2) some of the elements attributed to going value have already been allowed for liberally in preliminary and development expenses and in connection with the appraisal of physical property in the form of overhead charges; (3) much of the information and experience referred to is personal and does not go with the property. The fourth consideration is that many of the elements included in "going concern" are transitory or recurrent. Every new piece of machinery or plant must be tried out and adjusted, and all property, excepting possibly land, must be replaced from time to time. Thus the adjustment and adaptation involve continued expense. In so far as these elements are transitory and call for expenditures year after year, they should not be paid out of capital, but should be charged as a part of operating expenses. If the various expenses which go to make up "going concern" are to be charged to operation the company should be allowed to charge rates that would yield a sufficient income to pay them and allow a fair return upon a fair value of the property. If good management and foresight had been used in the initiation and conduct of the undertaking this statement would be sound, but it ordinarily happens that during the first few years of operation the company does not earn a fair return, and there are then two methods by which investors may be made whole.

One solution of the problem is to capitalize the losses or deficiencies below a fair return and all the other elements which are said to be included in "going concern." This would be accomplished by using the proceeds from the sale of stocks, bonds or notes to pay expenses for "going concern" and a fair return to investors. To use money from such sources would, the commission states, be absurd, dangerous and unjustifiable, and would probably result in bankruptcy and dissolution. The use of capital money to pay current expenses after operation has been begun is open to similar criticism. If the theory is sound that "going-concern" expenses are to be charged to capital, the wages or salaries paid to certain employees must be paid out of capital, and the question is asked, Who is to decide when this shall be done and when it shall cease after it has once been started? It is easy to fix a date when the construction period ends and operation begins, but it is asked how one may know when "going concern" expenses cease. The conclusion is that to follow this solution would open the door wide to over-capitalization, financial manipulation and misappropriation of funds.

The other solution is to charge all such expenses to operation, to attempt to make no fine-spun distinctions, and then to permit the company to charge in later years rates sufficient to offset its deficiencies below a fair return in the first few years. This method involves no question as to capitalization and cannot result in the inflation of securities. Ordinarily the company which is wisely managed follows this very course and works out an adjustment by itself. Questions only arise when the state, through some agency, is called upon to determine whether the rates are reasonable, and then the rate of return to be allowed upon the investment should be such as to offset losses in earlier years. The commission stated that this principle was adopted in the present case, and no further allowance was made for "going concern" in determining the fair value of the property.

The company had filed a statement of the requirements for improvements and betterments for the immediate future, of which $87,000 relates to electricity supply, $79,100 to gas and $8,500 to general property. These are divided by the commission into three groups, namely: (1) Repairs and replacements; (2) extensions and additions for future consumption; (3) additional plant to improve service. The decision states that the company is not entitled to capitalize or to earn a fair return upon the first group, for all repairs, renewals and replacements should be charged to earnings. The second group should also be omitted, for the additional consumption which these additions are to supply should, and doubtless will, provide a fair return upon new investment. Regarding the third group, the commission says that at the present moment the company does not have sufficient gas and electric plant to afford proper service, and allowance should be made for such additions as will be necessary to enlarge the business during the current year.

The final conclusion of the commission is that the company is entitled to earn a fair return upon $860,000 for the gas plant and $800,000 for the electric plant, or a total of $1,660,000. The standard set by the commission for determining a fair rate of return on this valuation is that the rate should be such that investors would be induced to provide the funds to construct and extend the gas and electric plant within the area in question. After considering all the facts the commission concluded that, in view of the circumstances surrounding the company and the character of the area within which it operates, a fair rate of return on both gas and electric undertakings for the purposes of the present case would not exceed 8 per cent. This rate would be equivalent to a dividend of 10 per cent upon stock equal to one-half of the fair value if bonds to the amount of one-half were financed upon a 6 per cent basis, or an 11 per cent dividend if bonds were on a 5 per cent basis. After consideration of operating results and costs and present local conditions the commission made the following estimate for the electrical department:

Cost of generating 4,150,000 kw-hours at 1.7 cents per kw-hour	$70,550
Other operating costs (including taxes but excluding depreciation) 2,820,000 kw-hours sold at 2.8 cents	78,960
Depreciation and other reserves	28,000
Return on fair value of property ($800,000 at 8 per cent)	64,000
Total	$241,510

Upon the other side of the account, excluding the energy supplied at the maximum rate, the following entries are made by the commission:

Street lighting, 800,000 kw-hours at 6 cents per kw-hour	$48,000
Lighting municipal buildings, 20,000 kw-hours at 10 cents	2,000
Commercial metered power, 700,000 kw-hours at 4 cents	28,000
Electric jobbing, etc	1,400
Rent of rooms in office building (one-half total)	1,000
Increase in value of land	6,300
Total deductions	$86,700

Subtracting this total from the cost of service, the commission obtains an amount of $156,210. Dividing this amount by the consumption at the maximum rate, 1,300,000 kw-hours, there is obtained an average of over 12 cents per kw-hour.

In explanation of the item of depreciation the commission states that experience has shown that the straight-line method for calculating depreciation produced a larger return than is necessary. First, some portion of the annual loss is made good by renewals and replacements regularly included in maintenance and already allowed for in operating expenses. So extensive, indeed, are the partial replacements and renewals usually included in current maintenance that many of the largest corporations under the supervision of the commission have taken the position that no special depreciation fund is required in their cases. The question whether depreciation is a proper operating charge is no longer open to debate. The opinion of Mr. Justice Moody in the Knoxville water case reflects the generally recognized rule that rates should be sufficient to permit current repairs to be made, parts to be replaced and other charges met, so that by one means or another the investment may be kept unimpaired. In order that this may be done every part of the property must be considered, and wherever there is a decrease in value provision must be made for an offset in one form or another.

The land owned by the company was taken by the com-

mission at what was called its fair value and not at its original cost, and annual appreciation of the land was ordered to be treated as a profit. If land or other property which generally appreciates in value is to be taken at its appreciated value, then an entry must be made in the estimated receipts equal to the annual average appreciation. The commission held that until this is done it is obvious that the consumer will be burdened with all the estimated decreases in assets and not credited with the increases in assets.

Public-Utility Commission Investigation in Illinois.

A committee of the Illinois Legislature, of which Senator John Dailey, of Peoria, is chairman, is investigating the subject of creating a public-service commission or commissions for that State. It has already made several trips, some of them out of the State, in gathering material on the subject, and now purposes to make a tour of Illinois to obtain first-hand information on the condition and requirements of public utilities. To this end the following itinerary has been announced:

Week of Monday, Nov. 13—Cairo, Marion, Carbondale, Murphysboro and East St. Louis; week of Nov. 20—Alton, Carlinville, Jacksonville, Quincy, Rock Island and Galesburg; week of Nov. 27—Peoria, Ottawa, Pontiac, Bloomington and Springfield; week of Dec. 4—Decatur, Mattoon, Champaign, Danville and Kankakee; week of Dec. 11—Joliet, Aurora, Elgin, Freeport and Rockford.

Public Service Commission News.

NEW YORK COMMISSION.

The Public Service Commission, Second District, has received a complaint from Milford D. Whedon, of the village of Granville, Washington County, directed against the New York & Vermont Home Telephone Company, alleging that the charge of 50 cents per month made by the said company for an extension telephone is excessive and unjust and should be reduced to a maximum of 10 cents per month. The complaint states that the company has refused to permit the complainant to install an extension telephone and connect it with a telephone of the company in his office and residence at his own expense, and that this refusal of the company is an injustice, unfair and unreasonable, and that he should be allowed to install such an extension telephone at his own expense without rent or other charge therefor in addition to the regular charge for telephone service. The complaint has been served upon the telephone company and an answer required within twenty days.

OHIO COMMISSION.

In the case of the Tiffin Art Metal Company against the Tiffin Consolidated Telephone Company Judge William F. Duncan, in the Common Pleas Court at Findlay, Ohio, has ruled that the public utilities act passed by the Legislature last winter is constitutional. The Tiffin Art Metal Company asked for an injunction to prevent the telephone company from removing the telephone from its office when it refused to pay a rental of $3 per month after the City Council had fixed a rate of $2.50 by ordinance. Attorneys argued that because the telephone companies were not specifically mentioned in the bill they do not come under its provisions. The court, however, held to the contrary and declared that the City Council has authority under the new law to fix telephone rates. The injunction was granted.

Attorney-General Hogan has rendered an opinion to the Public Service Commission to the effect that it is the duty of that body to make a valuation of telephone plants before the owning companies are allowed to connect them up for interchange of service, lease, merge or sell them. Mr. Hogan also suggests in this opinion that after the commission has made a valuation it shall determine the rates, tolls, charges and rentals to be made under the contract, purchase or lease.

A. F. Herbele, of Cincinnati, has filed a complaint with the commission to the effect that the Union Gas & Electric Company is discriminating against manufacturers, real-estate owners and merchants who own their own plants for the production of energy. It is claimed that some large manufacturing concerns which operate their own electric plants close down in the evening when the plants are not in use, and that unless the Union Gas & Electric Company furnishes energy the offices and buildings are in darkness. This company, it is claimed, charges owners of these private plants $3 per kw per month, while the charge to others is $1. The company, it is said, claims that it cannot make the connections and furnish the small amount of energy thus used for less where the owners maintain a plant for motor and lighting service the remainder of the time. The commission has set Nov. 24 for a hearing in Cincinnati.

MARYLAND COMMISSION.

Persons interested in the Maryland Public Service Commission are speculating as to what action will be taken by the Legislature concerning the law and also the course that will be pursued by the new Governor in making appointments to the commission. The term of Mr. Philip D. Laird, of Montgomery County, will expire next May, and the term of Dr. Joshua W. Hering will expire in May, 1914. Chairman Ambler's term will not expire until May, 1916, when another governor will have been elected. The present members of the commission are all Democrats, as are most of the employees. The commission, with the approval of the Governor, names its chief counsel, assistant counsel, secretary and engineer, while it has full power to name all other employees. Mr. William Cabell Bruse is chief counsel, Mr. Albert C. Ritchie assistant counsel, Mr. Charles E. Phelps chief engineer and Mr. Louis Duvall secretary.

WISCONSIN COMMISSION.

In conformity with its established policy, the Wisconsin commission has deferred a favorable decision on the application of the People's Telephone Company for an increase in rates until the company's accounts are properly kept and the plant is put into shape to render efficient service. The People's Telephone Company owns and operates six local exchanges with a general rural and toll service. The petition alleges that the present rates are not high enough to yield a reasonable return after providing for depreciation and to maintain the plant in a satisfactory operating condition. An increase in rates was requested for three of the six exchanges. On account of the fact that the company had not properly apportioned the revenues and general expenses for rural and toll service, it was impossible to determine accurately the financial condition of each of the several exchanges. From an analysis based upon the available information, and computing depreciation at 6½ per cent, it was evident that the rates in effect at two of the three exchanges were not ample. On the other hand, the rates petitioned for were too high in consideration of the service rendered. According to the company's reports for 1910, the average yearly operating cost per telephone for the three exchanges was $5.92. The commission was very doubtful whether the utility could furnish adequate service at so low a cost. In this connection the engineering staff reported that the complaints made of the service were due chiefly to the condition of the wire plant, and said that a thorough overhauling and repair were necessary steps toward the rendering of reasonable service. The investigation showed that the company's financial condition in general was good enough to warrant making the needed improvements in the service, with the possible exception of the two exchanges in controversy. In dismissing the application the commission conceded that in the case of the two

weaker exchanges an increase in rates was justifiable, but held that this action must be postponed until the company gets the exchanges into condition to render good service and keeps its accounts in a manner prescribed by law.

Two complaints have been filed with the commission by the city of Green Bay, one alleging that the Green Bay Gas & Electric Company's rates for gas and electric service are excessive and unreasonable, and the other that the rates for electric service charged by the Minahan Building Company are unreasonably high. The Gas & Electric Company's present electric rates range from 12 cents per kw-hour for a monthly consumption of from 9 kw-hours to 24 kw-hours to 2.5 cents per kw-hour for energy used in excess of 1300 kw-hours, with a discount of 10 per cent for prompt payment. According to this schedule, the majority of the residence lighting is paid for at the maximum rate. The company distinguishes in its gas schedule between the same gas sold for lighting purposes and for fuel, which is contrary to the established practice as followed by the commission in all of its past decisions. The present electric rates of the Minahan Building Company range from 8 cents for the first 100 kw-hours to 2.5 cents for all energy used per month in excess of 1200 kw-hours, with a discount of 5 per cent for prompt payment. The motor service rates range from 7 cents to 2 cents for the same quantities. The Minahan Building Company supplies energy to a restricted area in the business district. Both hearings will be held next month.

The commission has served notice upon the city of Evansville that it will immediately proceed to investigate the rules and regulations of the municipal electric-light plant. This action was the result of a complaint registered against the municipality, in which it was alleged that the rules and regulations were unreasonable and that the rates for service were unlawful and discriminatory.

CURRENT NEWS AND NOTES.

ADVERTISING ELECTRICAL NOVELTIES.—In the article on page 1142 of the issue of Nov. 4 entitled "Advertising Electrical Novelties" credit for the illustrations used should have been accorded to the Louisville Lighting Company, which company owns the copyright of the pictures.

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PROPOSED HYDROELECTRIC DEVELOPMENT ON ST. LAWRENCE.—According to reports from Ottawa, a company with capital of $100,000,000 is to be incorporated with a charter from the Dominion government for the purpose of developing the Cedars, Cascades and Coteau Rapids in the St. Lawrence River, which are entirely in Canadian territory. Sir Max Aitkens, a Canadian who is a member of the British Parliament, is said to be at the head of the enterprise.

* * *

POST-GRADUATE INSTRUCTION FOR PRACTISING ENGINEERS.—The government of Bavaria has arranged for courses of instruction which all government technical officials are required to attend at intervals of some years. The reason given for this action is that engineers after graduation do not have an opportunity while engaged in regular work to keep up with all the developments in their branch of engineering knowledge and need a period of systematic instruction at intervals to bring them up to date.

* * *

ELECTRICALLY DRIVEN DICTAPHONES IN MASSACHUSETTS TRIAL.—Motor-driven dictaphones are being used in a notable capital case which is being tried in the courts of Springfield, Mass., to facilitate the rapid preparation of stenographic reports of detail evidence and arguments. By this means the report of the case is kept within forty-five minutes of the proceedings in the court-room, and by 7 p. m. daily the complete corrected brief of each day's doings and sayings is available to the parties interested.

* * *

A. I. E. E. SMOKER.—At the recent meeting of the American Institute of Electrical Engineers in New York it was announced by Mr. Harold W. Buck, chairman of the meetings and papers committee, that immediately following the next meeting of the Institute in New York a smoker would be held in the society's rooms on the tenth floor of the Engineering Societies Building. During the informal portion of the meeting ample opportunity will be given to members for the discussion of engineering topics.

* * *

TELEPHONE SERVICE FOR ISLES OF SHOALS.—A submarine telephone cable has recently been placed in service between the Isles of Shoals, off the coast of New Hampshire, and the mainland. Wireless communication has been maintained across the 10-mile stretch of open sea separating these rocky outposts of civilization from the shore; but the requirements of speed and accuracy led to the demand for telephone connections. Soon after the installation of the cable a wreck occurred on Duck Island, and assistance was summoned from Portsmouth in record time. It is anticipated that the new service will be of the utmost value to summer residents as well as to denizens of the islands.

* * *

ELECTRIC-VEHICLE THESIS INVESTIGATIONS AT BOSTON.—In connection with the investigation of electric-vehicle problems which is being carried on by the electrical engineering department of the Massachusetts Institute of Technology for the Edison Electric Illuminating Company of Boston, Mass., a special study of the time-factors in urban freight handling will shortly be inaugurated. As a part of the required thesis work, an analysis will be made of the time required in handling shipments of freight in and about the large Boston railroad terminals, including the performances of horse-drawn trucks, gasoline trucks and electric commercial vehicles. Special efforts will be made to locate sources of inefficiency and, while the investigation will be pursued with entire absence of partiality, it is anticipated that some interesting and suggestive points on behalf of the electric truck will be forthcoming. The work is under the immediate supervision of Mr. H. P. Thompson, of the department of electrical engineering, who has lately visited all the large cities east of the Mississippi River in the quest of information upon the latest electric-vehicle practice and opportunities.

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BROOKLYN N. E. L. A. COMPANY SECTION.—More than 400 members of the Brooklyn Company Section of the N. E. L. A. were present at the November meeting, held on Monday evening, Nov. 13. Mr. Alden W. Welch presented a very instructive paper on "Low-Tension Electrical Conductors," describing the reduction of copper into finished wire and the manufacture and characteristics of low-tension cables. Mr. James L. Wiltse presented an excellent paper on "Charging for Electric Service," covering the theory and principles of rate-making. Each of these papers was followed by lively discussion in which members from nearly every department of the company participated. After presentation of the papers, Mr. M. J. Shugrue, president of the section, introduced Mr. Frank W. Smith, secretary of the United Electric Light & Power Company, of New York City, the speaker of the evening. His topic was "Co-operation," and in a highly interesting address enhanced by humorous and pertinent anecdote he contrasted the advantages of co-operation with the results of individual effort and complimented his listeners upon the high degree of company spirit and co-operation that they had shown throughout the evening. Refreshments and moving pictures of current events, including a film showing Mr. Thomas A. Edison's recent trip through the Alps, brought the program to a close.

New York Section, I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society to be held on Dec. 8 Dr. Ellice N. Alger will present a paper entitled "The Conservation of Vision."

* * *

Baltimore N. E. L. A. Section.—The Baltimore Section of the National Electric Light Association has announced the following subjects for the lectures that will be given this coming season at the Johns Hopkins University by Dr. John B. Whitehead, professor of applied electricity at the university: Nov. 14, *Methods of Producing Power, Light and Heat;* Nov. 28, *The Value of Electricity as a Form of Energy;* Dec. 12, *Magnetism and Iron in Electrical Apparatus;* Jan. 2, *Dynamo-Electric Machinery;* Jan. 16, *Transmission and Distribution;* Jan. 30, *Electric Motors;* Feb. 13, *Transformers;* Feb. 27, *Electric-Lighting Devices;* March 12, *Principles of Illumination;* March 26, *Design of Illumination.*

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Philadelphia Section, N. E. L. A.—Among the principal speakers at future meetings of the Philadelphia Electric Company Section of the National Electric Light Association will be the following: Dr. C. P. Steinmetz, on Nov. 20, upon the subject "The Effect of Reactance on Alternating-Current Circuits and Apparatus"; Mr. A. H. Armstrong, on Dec. 18, his subject being "The Coming of the Electric Locomotive"; Dr. E. F. Smith, on Jan. 15, upon the subject, "How the Chemist May Use Electric Current"; Mr. Caryl D. Haskins, on Feb. 19, on the subject "The Electric-Lighting Industry, Past, Present and Future," and Mr. J. J. Carty, on March 18, and Mr. H. L. Doherty, on April 15, upon subjects not yet announced.

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Railway Electric Supply Manufacturers' Association.—At the annual meeting of the Railway Electric Supply Manufacturers' Association, held in Chicago on Nov. 9, during the convention of the Association of Railway Electrical Engineers, Mr. George H. Porter, of Chicago, was elected to the presidency, receiving a well-earned promotion from the vice-presidency. The full list of officers is as follows: President, Mr. George H. Porter, Western Electric Company; vice-president (East), Mr. H. G. Thompson, Edison Storage Battery Company; vice-president (West), Mr. W. F. Bauer, United States Light & Heating Company; secretary, Mr. J. Scribner, General Electric Company (Chicago office); treasurer, Mr. Edward Wray, *Railway Electrical Engineer;* executive committee (new members), Messrs. C. W. Bender, National Electric Lamp Association; J. G. Van Winkle, Safety Car Heating & Lighting Company; J. J. Schayer, Niagara Lead & Battery Company; W. C. Lawler, Gould Coupler & Storage Battery Company.

* * *

Operation of Single-Phase Railway in Winter.—It is reported that the Spokane & Inland Empire Railroad Company, which operates an 11,000-volt single-phase line in the State of Washington, was the only one in the locality that maintained its regular scheduled service throughout the winter of 1909-10, which was the most severe ever experienced in that vicinity. On a railroad the ability of a steam locomotive to haul loads is actually reduced in cold weather because of the greater losses of heat from the locomotive. The reverse is true with an electric locomotive, because in cold weather the motors are maintained at a much lower temperature than in warm weather, hence their permissible outputs are increased. An additional reason for the success of the single-phase line has been that at the high voltage the current is so low that the voltage is maintained up to almost normal, even when the motors on the locomotives or cars are operating at large overloads. Upon an ordinary 600-volt road when the car "bucks" the snow the current consumption is so great that the line voltages usually drop to a value too low for effective operation.

Telephone Pioneers Convene at Boston.—Three hundred men who had been closely identified with the early days of telephony met in convention at the Hotel Somerset, Boston, on Nov. 2 and 3, to organize an association to be known as the Telephone Pioneers of America. Membership in the association is contingent upon a service of at least twenty-one years in the telephone field. Gen. Thomas Sherwin, of Boston, presided, and the following officers were elected: President, Mr. Theodore N. Vail, Boston; vice-presidents, Messrs. F. H. Bethell, New York; W. T. Gentry, Atlanta, Ga.; B. E. Sunny, Chicago, and E. B. Field, Denver, Col.; secretary and treasurer, H. W. Pope, New York; executive committee, Messrs. Thomas D. Lockwood, Boston; John J. Carty, New York, and Francis A. Houston, Boston. A feature of the convention was an address by Dr. Alexander Graham Bell, giving many interesting details of the invention and early service of the telephone. An elaborate exhibit of early telephone material and apparatus was displayed, including the first telephone switchboard, 2 ft. in length, parts of the original Bell telephone of 1875 and other priceless relics of the industry.

* * *

National District Heating Association.—The executive committee of the National District Heating Association met in Detroit, Mich., on Nov. 8 and 9, and after considering invitations from Niagara Falls, N. Y.; Rochester, N. Y.; Buffalo, N. Y.; Chicago, Ill., and Detroit, Mich., unanimously decided to hold the fourth annual convention in Detroit on June 25, 26 and 27, 1912. Papers upon the following subjects will be presented at this convention: "Depreciation in Underground Distribution Systems," "Operation of Turbines and Reciprocating Engines in Connection with Steam-Heating Work," "Description of a Combined Steam-Heating, Ice-Making and Electric-Power System," "Radiation Tests," "Heat Losses in Steam Distributing Systems," "Description of a Large Hot-Water-Heating System," "Quality of Steam Supply as Affected by Use of Superheat at Station," "Decentralized Heating Plants," "Relative Economies of One-Pipe and Two-Pipe Heating Systems in Buildings," "Sources of Trouble in Customers' Installations," "Thermodynamic Economy of Combined Power and Heating Systems" and "Different Systems of Underground Construction." One paper is to be presented by the Cleveland Electric Illuminating Company on a subject not yet announced. Mr. D. L. Gaskill, Greenville, Ohio, is secretary.

* * *

A 1500-Volt Direct-Current Road in the Carolinas.—Nearly 150 miles of track will be equipped for 1500-volt direct-current operation, when the new system of the Piedmont Traction Company and the Greenville, Spartanburg & Anderson Railway Company is completed in North and South Carolina. The mileage electrified is one of the largest high-voltage direct-current installations ever undertaken, and the pressure, 1500 volts, is about 300 volts higher than has been heretofore employed. The equipment will include both passenger cars and locomotives for hauling freight, the motors being of a special interpole type connected permanently two in series on 1500 volts. A secondary feature of this 1500-volt equipment will be the use of a dynamotor to drive the car compressor by means of a friction clutch of a standard automobile type, the clutch being automatically cut in when the air pressure reaches a certain limit. The dynamotor ordinarily furnishes power for the control circuits and lamps, but in this case it will serve also to operate the compressor. The dynamotor is arranged to operate on the 600-volt lines at the regular speed, thus enabling the air pressure to be kept up better than is possible where 1200-volt compressor motors are used and operated at half speed or less on the low-voltage lines. It is also of interest to note that the 1500-volt equipment will be furnished by the Westinghouse company.

THE WORLD'S PIONEER HIGH-TENSION TRANSMISSION SYSTEM.

THE GENERATING AND TRANSMISSION SYSTEM OF THE TELLURIDE POWER COMPANY.

Evolution from 100-hp Generator in 1890 to Eight Generating Stations Aggregating 40,000 hp and Supplying 600 Miles of Transmission Line in Three States.

IF the modern systems of high-tension electric transmission which are revolutionizing industrial conditions within economic radius of their generating stations, that of the Telluride Power Company occupies a place of unique interest. The organization enjoys the distinction of being the pioneer enterprise of its character in the world, the company having been the first to undertake commercially to transmit high-pressure energy, antedating the celebrated Frankfort-Lauffen experiment of 1891 by about a year. In the light of modern transmission practice, with its increasing reliability of service over distribution areas covering in many cases thousands of square miles of diversified country, the work of the initial plant at Ames, Col., seems to belong to the remote past, and yet it is barely a score of years since the triumph of electricity in that remote mountainous district at the hands of Messrs. L. L. and P. N. Nunn disproved the skepticism of the outside world and signalized the beginnings of the present great dual systems of the company in Colorado, Utah and Idaho, comprising eight power stations having a rating of over 40,000 hp, 35 miles of flume and pipe line, about 600 miles of transmission lines, 400 miles of telephone line and distributing networks. An outline of the operating conditions of the system in Colorado and Idaho was given in our issue dated July 15, 1909.

It is noteworthy that the original work at Ames was based upon the necessity of supplying energy at a figure competitive with steam, the situation being acute on account of the prohibitive cost of coal in the San Juan district. In these days of operating economy it is easy to lose sight of the fact that the pioneers of hydroelectric transmission were obliged to develop their markets through the most vigorous competition with the established forms of motive power and to operate their systems with apparatus which was crude and experimental to the last degree. That it was possible to attain commercial success in the face of such obstacles speaks volumes for the courage and ability of the financiers and engineers associated with the early history of the art and encourages the belief that subsequent progress is but the preliminary to a future development beside which the work of to-day will appear incomplete and probably as crude relatively as the original practice seems to the modern observer.

The history of the Telluride Power Company is a continuous record of independent research in the transmission field, and the organization has never sacrificed the lead which its management assumed in establishing the Colorado service of 1890. From the first experiments with 3000-volt synchronous transmission at Ames to the latest investigation of automatic relays suitable for operation in networks the company has maintained the spirit of scientific investigation within its organization, co-operating with the manufacturing companies, no less than determining its own advanced standards of equipment and methods. At its headquarters at Olmsted, Utah, the company to-day maintains a research laboratory which would do credit to any university, and the facilities there afforded for experimental study of transmission problems are unique in commercial power organizations.

EARLY DEVELOPMENT.

Only passing mention can be made of the company's early development in connection with a survey of the present systems. The initial plant was installed at Ames in order to meet a critical industrial situation at the Gold King mill, situated at an altitude of 12,000 ft. and in the heart of one of the richest and most rugged gold-bearing districts of the Rocky Mountains. On account of the excessive cost of steam service—soft coal selling at about $35 per ton at the mill—the property was confronted by an attachment, whereas its commercial success would have been assured with a substantial profit had it been possible to produce energy at $100 per hp-year. A stay of proceedings was secured and a generator and motor, wound for 3000 volts, single-phase, and rated at 100 hp each, were installed and connected by two No. 3 bare copper wires mounted upon short Western Union cross-arms and porcelain insulators, the line being 2.6 miles in length. The generator was installed in a rough cabin on the site of the present Ames station and belt-driven from a 6-ft. Pelton waterwheel operating under a head of 320 ft. The generator and motor were duplicate Westinghouse alternators, the largest machines manufactured at that time. The generator was separately excited, the motor being self-exciting. Each was provided with a twelve-part commutator and was slightly compounded through series transformers mounted upon opposite spokes of their armatures, the latter being of the iron-clad type, with twelve coils carried in fullerboard and mica cells. Circuits were closed with jaw switches and opened by arc-lamp plugs. Less than 5 per cent loss was encountered in the line and the cost of copper was only $700, compared with an estimated expense of $70,000 for copper with direct-current energy transmission. The motor was brought up to synchronous speed by a single-phase induction starting motor, the latter being turned initially by hand on account of its feeble starting

torque. The initial plant ran thirty days without a stop. Many difficulties were encountered and overcome, notably those arising from the severe lightning storms of the district, which comprises some of the most exposed mountain ranges in the United States. The use of T-toothed armatures with replaceable coils proved to be the plant's salvation, but the excessive number of burnouts led to the construction of various types of lightning arresters, leading to the development of the Wurts non-arcing equipment.

EXPANSION OF ORIGINAL SYSTEM.

The success of the Ames plant soon resulted in the expansion of the system, a 600-hp generator being installed in 1892, with transmission to a 250-hp motor 10 miles distant. In 1894 the transmission distance was increased to 14 miles, energy being supplied to motors in the famous Savage Basin, near Telluride. In 1891 the company's first lighting transformer was placed in service, and experience soon demonstrated the value of immersing the device in engine oil as a protection against lightning. Alternators were first paralleled by the company in 1893.

Even in these early days the value of technical education was appreciated by the company and special facilities were accorded station operators for the prosecution of daily study and shopwork, with a technical library and laboratory constantly at hand. In 1896 the Tesla induction motor system superseded the synchronous installations. In 1900 the company built a 1200-kw generating plant at Ilium, 6 miles below Ames on the south fork of the San Miguel River, the machine being directly connected to two impulse wheels operating under a 500-ft. head. Duplicate transmission lines were installed and among the contemporary improvements effected were the use of masonry compartments for transformers, the provision of line sectionalizing switches of the open-air type, the installation of junction houses at distributing centers, use of recording instruments, inauguration of a 10,000-volt underground transmission at the Gold King mine, and in 1895 the institution of the celebrated experiments with transmission at potentials of from 30,000 volts to about 60,000 volts.

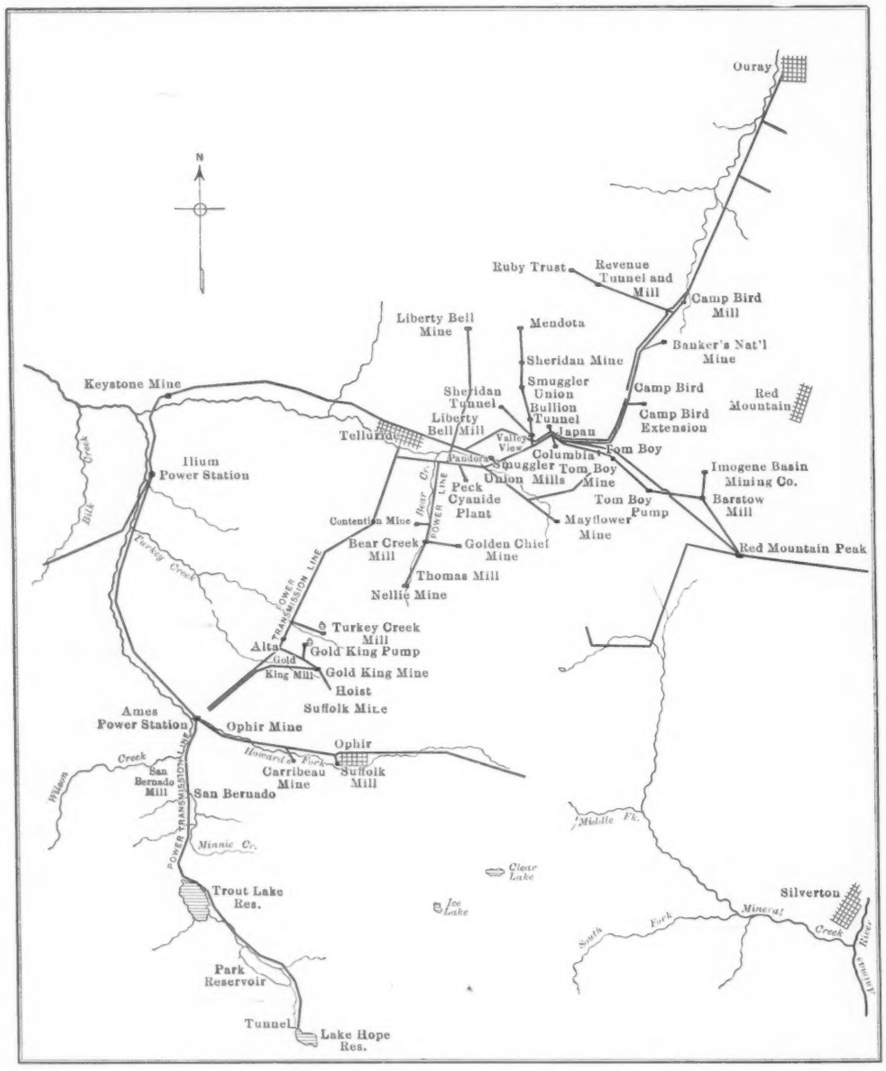


Fig. 1—Map of Colorado System.

The latter experiments were undertaken to throw light upon the feasibility of transmitting electricity over larger areas from important water-power plants contemplated in Utah and Montana by the company.

The original plant at Provo, now known as the Nunn station, contained two 750-kw, 800-volt, 60-cycle, three-phase generators directly driven by horizontal twin turbines operating under a head of 125 ft. From this plant energy was transmitted over a single line to Mercur, 32 miles distant, at a pressure of 40,000 volts, this being the first commercial system operating at the above potential, which was at the time nearly three times the voltage previously employed by any transmission company in its service. The Provo-type insulator, a triple-petticoated glass outfit, with double neck and serrated bottom edge, was developed for this service, and on some of the older portions of the present system these insulators are still in use, although porcelain was long since adopted as the company's standard. In 1901 a plant was installed at Logan, Utah, containing two 1000-kw revolving-field alternators directly driven by waterwheels operating under 212 ft. head, this plant being tied to the Provo system by duplicate lines over 100 miles long. A new station at Olmsted, near Provo, was completed in 1905, this containing three 2400-kw generators directly driven by waterwheels operating under 340 ft. head.

LATER DEVELOPMENTS.

The later growth of the system includes the addition of a 300-kw station at Ouray, Col., in 1905; the construction of a 3600-kw station near the site of the original plant at Ames; the rebuilding of the Ilium station, and the doubling and extension of the transmission system in the Telluride district, with the construction of new lines into the Red Mountain region and many additional branches to new consumers. Within the Utah department of the company,

which operates a system having no electrical connection with that in Colorado, a plant at Jordan Narrows was purchased in 1906, its rating being 1300 hp; a plant at Battle Creek, a few miles from Olmsted, was built in 1906, with 2400-kw equipment; and in 1906-7 a new plant was built by the company at Grace, Idaho, the total rating of the generating units being 11,000 kw. This station is connected with the Logan plant by duplicate transmission lines and was designed for ultimate operation at 88,000 volts.

The Colorado department of the company serves a market situated in the rich mining districts of San Miguel and Ouray Counties, and within easy transmission distance of the San Juan district are fertile agricultural lands and promising towns. Apart from the mining load, which is extremely stable in this locality, the requirements of lighting, industrial motor service and irrigation are such as to indicate substantial increases in output in the future.

The Utah department serves a diversified market located in general within from 50 to 75 miles of Salt Lake City, including the supply of energy to the local central-station organizations at Salt Lake and Provo and to the noted mining camps of Bingham, Garfield, Eureka, Mercur, Topliff and to various important industrial organizations. All the electric railway systems in Utah now receive their energy wholly or in part from the Telluride Power Company. Important irrigation and pumping projects are also under consideration.

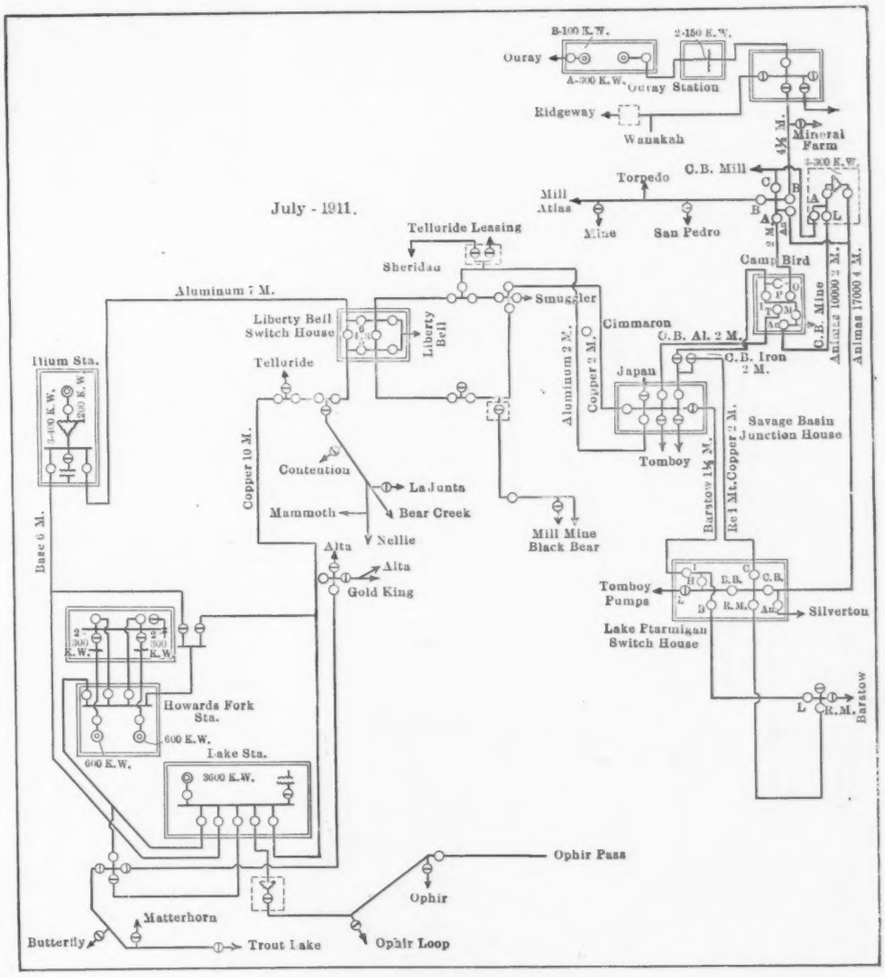


Fig. 2—Diagram of Colorado System.

WATER RESOURCES, COLORADO DEPARTMENT.

The sphere of operations of the Colorado department lies within the so-called San Juan district, in the southwestern part of the State. About 6 miles southeast of Telluride an apex in the mountain range forms the divide of three watersheds draining into the following rivers: The Uncompahgre, flowing north into the Gunnison; the south and east forks of the San Miguel, uniting west of Telluride and flowing into the Dolores and later the Grand River; and the Animas River, flowing south into the San Juan. The Dolores also rises near the apex and flows southwest into the Grand River. Topographically the region is characterized by mountain peaks attaining elevations of from 13,000 ft. to 14,000 ft. above sea level, the mean elevation of the intervening valleys and basins being from 5000 ft. to 9000 ft. Heavy forest growths abound upon the western and northern slopes of the divide. In spite of the fact that the lowlands surrounding the headwaters are arid the precipitation upon the region near the divide is heavy, ranging from 40 in. to several times that amount at higher elevations. Perpetual snow is found on the higher portions of the range and the run-off is great on account of the rocky character of the basins.

The total drop from the highest lake on the headwaters of the south fork of the San Miguel River to its mouth, a distance of 12 miles, is about 4000 ft. The south fork is formed by two branches known as Lake and Howard's forks, which head near the summit of the divide. All the waters of the south fork are controlled by the power company. A system of three reservoirs holds a portion of the flood waters of Lake Fork for use during the period of minimum natural flow. Lake Hope, the highest reservoir, 11,700 ft. above the sea, has an area of 38 acres at spill level, with a very great depth, due to a crater formation. The surface of the original lake has been raised by a rock-filled dam, 20 ft. high, with rubble masonry on the water side, a water-tight face being formed by horizontal sheeting spiked to timber embedded in the masonry. An outlet tunnel taps the lake 140 ft. below spill level, and the outflow is controlled by an 18-in. valve and pipe carried through a masonry bulkhead. The reservoir capacity is 140,000,000 cu. ft. Water from the lake flows through a natural channel 3 miles long into Trout Lake, a natural reservoir of 162,000,000 cu. ft. storage capacity, located at an altitude of 9700 ft. and having a surface area of 142 acres. Between Lakes Hope and Trout is situated a middle reservoir with a storage capacity of 30,000,000 cu. ft. The drainage area above the outlet of Trout Lake is 14 sq. miles, the total precipitation on which, less evaporation, is available for hydroelectric development. The high-water period lasts from about June 1 to Oct. 1. During the seven winter months stored water is necessary to supplement the natural stream flow.

Howard's Fork heads about 4 miles above Ophir and after flowing 8 miles it joins Lake Fork at Ames. Although no storage has been developed on this stream, full advantage may be taken of the varying stream flow during the dry months by using the Lake Fork reservoirs to supply only the difference between the Howard's Fork flow and the power demand.

The Uncompahgre River rises on the northern slope of the divide, several miles east of Telluride and about 8 miles south of Ouray, thence flowing northward through Ouray to the junction with the Gunnison River. The watershed is similar topographically to that of the San Miguel River, the slopes being rugged with steep sides and heavy forest growths. At Ouray the drainage area is about 24 sq. miles. The high-water season begins from one to two months earlier than in the Lake Fork watershed, making the watershed of more value than the minimum flow indicates. Between the points of diversion and return to the plant at Ouray the stream drops 470 ft. in a distance of 6200 ft.

NEW AMES PLANT.

The Ames power station is located near Ophir, at the junction of Lake and Howard Forks of the San Miguel River. From Trout Lake an outlet pipe 42 in. in diameter taps the lake 30 ft. below the spillway, there being an intake well of concrete, 9.5 ft. x 12 ft. x 9 ft. inside dimensions. The flow is regulated by a 42-in. Chapman sluice gate. The outlet pipe discharges into a 24-in. x 30-in. wooden flume 13,000 ft. long and having a grade of 4.8 in 1000. The flume ends in a steel tank which provides peak load storage and assists regulation. From the regulating tank a steel penstock 2700 ft. long carries the water to the power house, the upper end being steel-riveted and the lower end lap-welded pipe, the diameter varying from 30 in. to 26 in. At the bottom of the penstock there is installed a "Y" with a gate valve in each branch, the arrangement permitting the use of the water in either the new or the old station at Ames. The water from Howard's Fork is carried about a mile along the mountain side from the point of diversion in a 24-in. x 30-in. wooden flume, terminating in a pressure box from which a penstock of riveted and lap-welded steel pipe 2000 ft. long and from 24 in. to 18 in. in diameter leads to the plant, terminating in a valved "Y" also allowing the use of the water in either the old or new sections of the station.

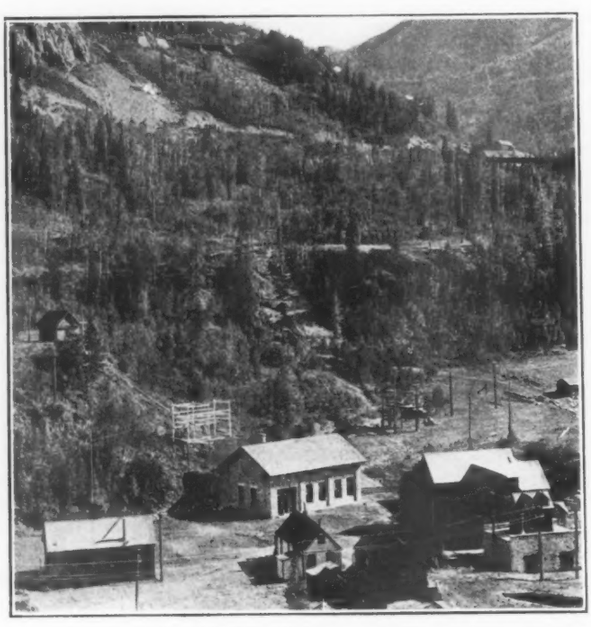


Fig. 3—View of Ames Station.

The Ames plant consists of two sections, one containing a 3600-kw generating unit with two waterwheels mounted upon a common horizontal driving shaft, and the other housing two 600-kw generators, each being directly connected to a waterwheel. The larger unit is installed in a new stone building known as the Lake station, and by the "Y" connections in the pipe lines above mentioned the generator may be driven either by a 5000-hp wheel drawing water under a head of 918 ft. from the Lake Fork system or in part by a 1200-hp wheel taking water from the Howard's Fork supply. This wheel is not shown in the station drawing, but the wheel-pit and generator-shaft extension for it are indicated. The station building is 58 ft. x 48 ft. over all, with standstone foundations laid in cement on concrete footings, the roof being of shingles carried on steel trusses with metal lath and plaster on the under side. The larger wheel is a Pelton outfit, with deflecting needle nozzle operated by a hydraulic cylinder under penstock pressure, the control being by pilot valve near the switchboard. The flow to the nozzle is controlled by a 24-in. hydraulically operated gate valve. The 1200-hp wheel is also a Pelton equipment, delivering its rating under a gross head of 626 ft. The nozzle is of the rigid needle type with stream deflector operated either by governor or by hand, the needle being controlled by hand wheel and gearing. The 3600-kw generator is a three-phase, 11,000-volt revolving-field machine of General Electric make, with a 75-kw, 125-volt exciter belt-driven from the shaft at a speed of 550 r.p.m.

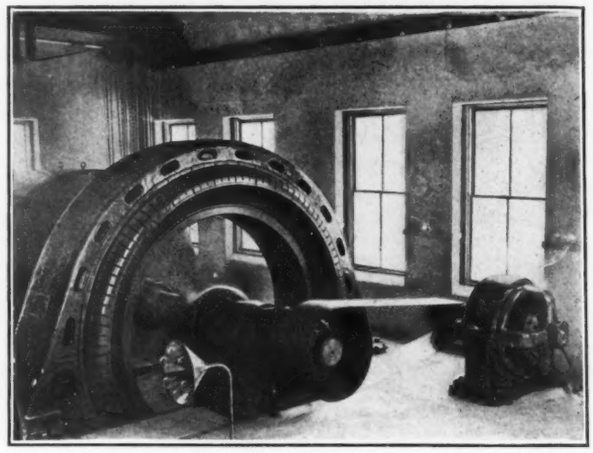


Fig. 4—Generating Unit at Ames Station.

ELECTRICAL FEATURES.

Energy from the generator is passed through an oil switch in the basement near the foundation and carried in 11,000-volt, rubber-insulated cables in fiber conduit along the basement ceiling to a bus structure mounted in concrete framing with asbestos barriers beneath the station switchboard, which is a four-panel installation located on the floor of the operating room, the latter being of reinforced concrete. On the main floor of the station five line switches of 15,000-volt rating are mounted in concrete cells and controlled from the switchboard by bell cranks. The switchboard contains one generator panel and three panels controlling two feeders each, with the usual instrumental equipment. On a reinforced-concrete gallery above the switchboard are mounted instrument transformers and protective apparatus consisting of spiral choke coils and electrolytic lightning arresters connected for the ungrounded neutral operation. Automatic overload relays are installed in connection with the oil switches on each of the outgoing lines, which leave the building through fiber concrete bushings set in sewer tile. In the operation of the station the Howard's Fork wheel of 1200-hp rating utilizes the total of the varying stream flow so far as possible, the

plant drawing upon the Lake Fork system merely for the rest of the demand. Three 400-kw transformers are installed in a corrugated-iron building outside the station for supplying energy at 17,500 volts to a feeder serving

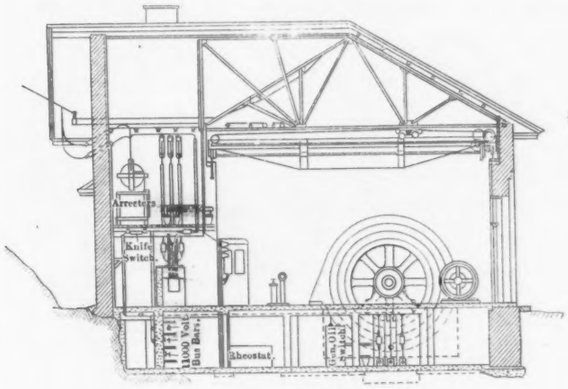


Fig. 5—Cross-Section of Ames Station.

Ophir Pass. Disconnecting switches are installed on each side of the feeder oil switches in the station.

OLDER AMES PLANT.

The older section of the Ames station illustrates the last remodeling of the company's earliest development in Colorado, utilizing the same waterways as the new section and serving mainly as a relay to the latter. The hydraulic equipment consists of two 900-hp Pelton wheels, each flexibly coupled to a 600-kw, 500-volt, two-phase Westinghouse generator operated at 327 r.p.m., the generators being of the revolving armature type. Each wheel is equipped with gate valves and deflecting nozzles, and one uses Howard's Fork water under a gross head of 626 ft., and the other Lake Fork supply under a gross head of 918 ft. Two 22.5-kw exciters are provided, each being belt-driven from the generator couplings. The generator leads are carried under the floor to a seven-panel switchboard, from which connection is made to four 375-kw transformers which raise the potential to 11,000 volts, three-phase, for the transmission of energy throughout the system. The outgoing leads are rubber-insulated cables carried on glass insulators, connecting with fused air switches and line outlets. Spiral choke coils and Westinghouse type "C" lightning arresters are installed in the old station. The two sections of the plant are tied together on the high-tension side, the jumper line being carried out of the old building through paraffined oak bushings.

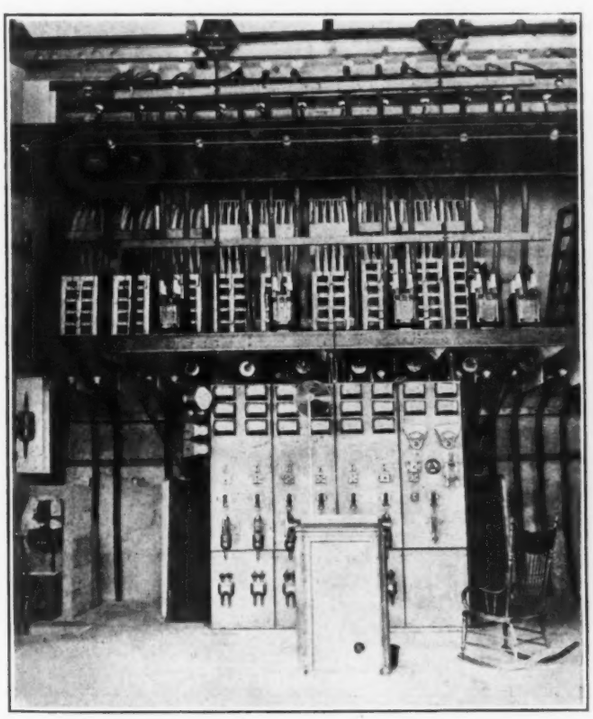


Fig. 6—Ames Station Switchboard and High-Tension Gallery.

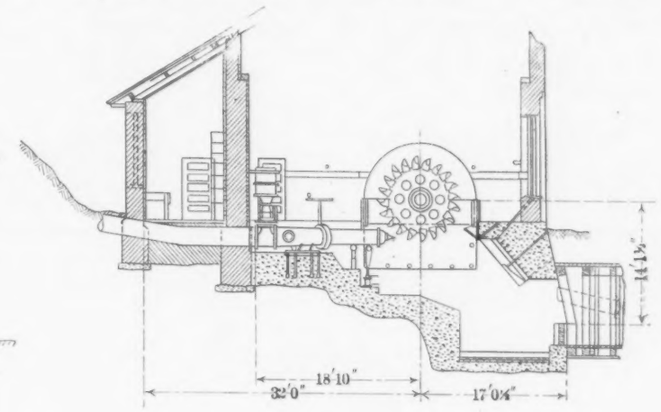


Fig. 7—Cross-Section of Ames Station.

ILIUM PLANT.

The Ilium station is located about 5 miles below Ames on the Lake Fork of the San Miguel River. Water is supplied directly from the Lake and Howard Forks and also from the tailrace of the Ames plant, in addition to which several small creeks are diverted into the flume connecting the two stations. The waterway consists of 28,600 ft. of wooden flume, 42 in. x 32 in. in section, and 873.5 ft of pipe line. The lower end of the flume, 750 ft. long, is enlarged to a 12-ft. x 16-ft. section to provide peak-load storage. The penstock is of lap-welded steel pipe with flanged joints, the diameter varying from 32 in. to 28 in. The station building is an uncoursed rubble structure, 74 ft. x 30 ft. outside dimensions, with a 12-ft. x 22-ft. shop under the same roof. Stone foundations are used; all floors are of reinforced concrete, and the roof is carried on a steel-truss installation. A 15-ton crane serves the operating room.

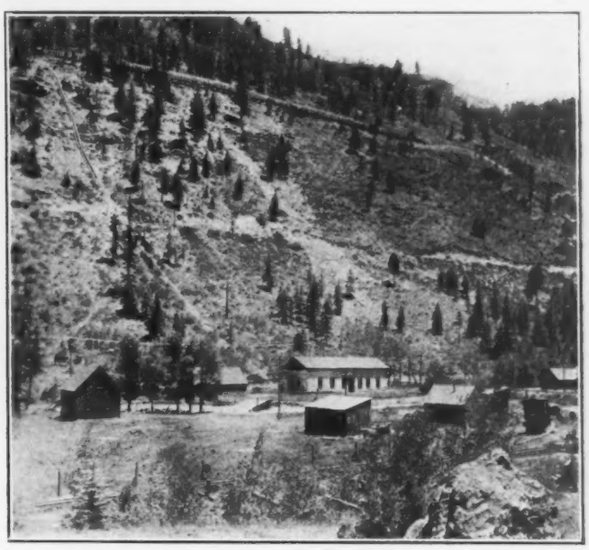


Fig. 8—View of Ilium Station.

The generating equipment consists of a 1200-kw, 1050-

volt, three-phase General Electric revolving-field alternator, running at 200 r.p.m. and directly driven on a horizontal shaft by two 8-ft. Pelton waterwheels. The lower end of the penstock terminates in a "Y-casting," to each branch of which is attached a 12-in. gate valve with a deflecting nozzle operated by a hand lever. The wheels deliver a total of 1600 hp under a head of 480 ft. net. On the inboard supply pipe a motor-operated needle is installed, the motor being a 2 hp, 220-volt induction equipment geared through a worm to the driving mechanism. A 25-kw, 125-volt exciter running at 1100 r.p.m. is belted to the coupling between the generator and the wheels. From the generator insulated leads are carried along the basement wall to an oil switch beneath the switchboard, which consists of two panels, one controlling the generator and the other two outgoing feeders. Overload relays are provided for disconnecting defective lines. At the end of the operating room three 400-kw, 1050-volt to 11,000-volt Converse transformers are installed in a bay below the operating-room floor level, the connections being delta on both the primaries and the secondaries. Beyond the transformers the outgoing leads are passed through two 15,000-volt oil switches to the lines, the connections being so made that lines may be looped through the station operating the generator, or if desired the latter may be operated on either or both of the incoming lines. Hourglass choke coils and electrolytic lightning arresters are installed, and the outgoing lines emerge from the building through Locke 15,000-volt outlet bushings. The usual disconnecting switches are provided on each side of the feeder switches. A 10-kw lighting transformer for station service at 110 volts is in service. In order to indicate the height of water in the pressure box use is made of a float with a mechanical connection to a rheostat arm in series with a voltmeter on one side of a 110-volt circuit. The voltmeter is calibrated in depths of water and shows the conditions at the pressure box by readings determined by the position of the float arm.

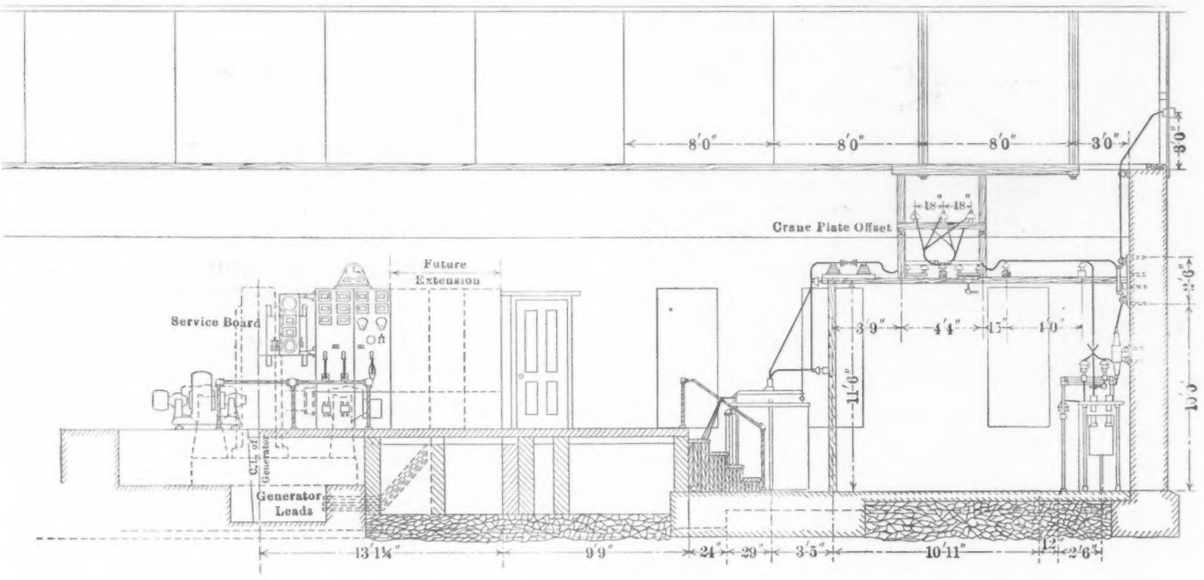


Fig. 9—Section of Ilium Tower Station.

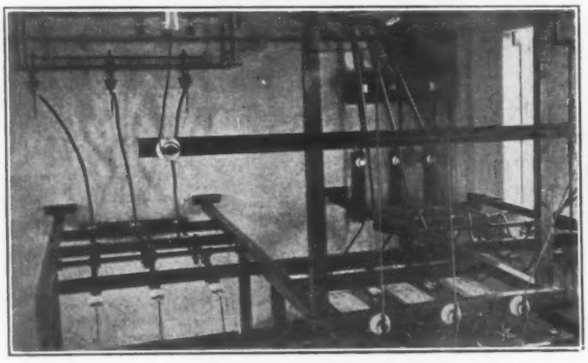


Fig. 10—High-Tension Framework at Ilium Station.

OURAY PLANT.

The Ouray station of the company is a plant of 300-kw rating, located in the town of Ouray, on the Uncompahgre River. About a mile above the station a dam of the rubble-masonry arched type, 85 ft. high, 75 ft. long and about 16 ft. thick, is in service between cliffs on each side of the river. From the dam a total length of 6200 ft. of riveted steel pipe, varying in diameter from 30 in. to 22 in., connects with the power house, the intake being about 8 ft. below the top of the dam. A single head gate regulates the flow. Air valves and expansion joints are included in the pipe line, and the total head from the reservoir to the shaft center is 440 ft.

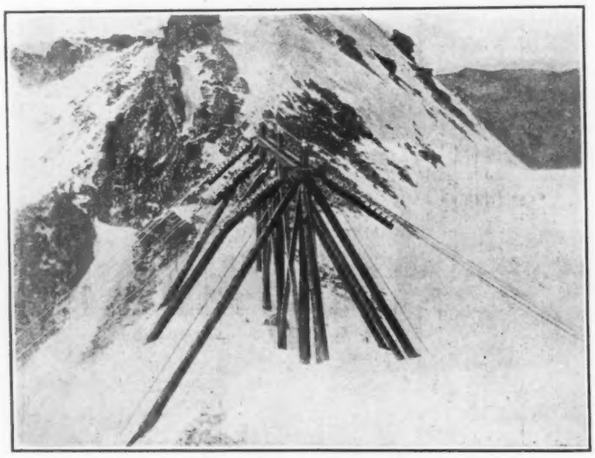


Fig. 11—Strain Tower, Camp Bird Divide.

The generating equipment consists of a 300-kw, 2200-volt, two-phase alternator, direct-connected to a pair of

Pelton wheels, and a 185-kw, 2300-volt single-phase machine belted to the same prime mover and used for local lighting. Two Scott connected 200-kw transformers serve to connect the station to the transmission system.

COLORADO TRANSMISSION SYSTEM.

About 90 miles of three-phase, 10,000-volt, 60-cycle lines

Fig. 12—10,000-Volt Transmission Tower at Camp Bird Divide.

comprise the transmission and distribution system of the company in Colorado. The principal center of load is at the Savage Basin, near Telluride, where a junction house has been erected near the Tomboy Mine, 12,000 ft. above sea level. Main lines extend from each power station on the system to this junction house, consumers being supplied with energy by feeders running from this junction house and by taps from the main transmission lines. A comprehensive system of loops, cross-overs and junctions forms an insurance of the service against line failures.

The system load-factor on a monthly basis is about 80 per cent and the power-factor about 78 per cent. The conditions are tending toward the gradual installation in the future of a 17,000-volt system, with shorter spans on the pole lines on account of the severe weather conditions encountered. Considerable difficulty has been experienced with the breakage of aluminum lines in the winter season and from swinging short-circuits in summer. In bad localities the transmission wires are frequently separated by a 4-ft. spacing, but in ordinary wooden-pole construction the spacing is somewhat less.

All power stations and important switching points are connected by a private telephone system, the operating headquarters of the company being at Telluride. The telephone lines are carried on separate poles at a safe distance from the main circuits.

GRAPHIC METERS.

The use of recording meters has attained a considerable development in both Colorado and Utah Departments. A typical curve from a mine and mill installation is shown herewith, the instrument showing the power fluctuations clearly as the various machines are thrown into and out of service. In the case in hand the mill demand was fairly constant at 35 kw; the operation of a 300-ft. hoist imposed an instantaneous peak of about 75 kw upon the system, with a demand of 55 kw when hoisting steadily, and the addition of a rock crusher and compressor imposed fluctuations calling for a total demand of from 120 kw to 150 kw. The graphic meter also shows the time required to operate the hoist through the different steps of its cycle, the effect of coasting down the shaft, period of emptying and the time consumed in hoisting, etc. These instruments are largely of the electric winding type and furnish invaluable records concerning the extent and periods of power demand upon the system.

Descriptions of the Utah system will follow in subsequent issues.

ELECTRIC FURNACE IN STEEL MAKING.

Addressing the Electric Club of Chicago, Mr. Charles G. Osborne, metallurgical engineer with the Illinois Steel Company, enumerated four methods of making steel, the Bessemer, open-hearth, crucible and electric-furnace processes. The last named is destined to be one of the most important of all, owing to its convenience in applying great heat. The United States Steel Corporation has three electric furnaces in its steel mills, one at Homestead, one at Worcester and one at South Chicago. Three large electrodes are used in each, and 25-cycle alternating current is used at a terminal emf of 55 volts or less. From the steelmaker's point of view forty arcs would be better than three, as that would afford a more uniform temperature. Steel made by the electric-furnace process is said by some to be better than other steels. The economy of production is about that of the crucible process in comparatively small quantities as now made, but would probably equal the open-hearth process if used as extensively.

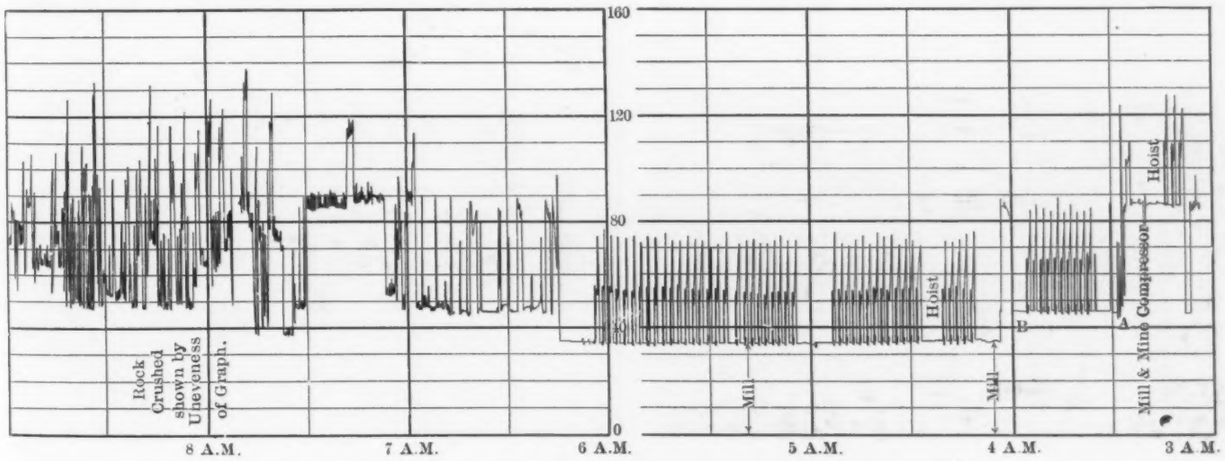


Fig. 13—Load Fluctuations in a Mill and Mine Installation.

PRUSSIAN-HESSIAN SINGLE-PHASE RAILWAY.

Single-Phase Commutator Locomotives for Passenger nd Freight Service.—10,000-Volt Trolley System, 60,000-Volt Underground Transmission, Single-Phase, 15-Cycle Generators.

DURING the present year an interesting 15-cycle, 10,000-volt, single-phase traction system receiving energy through underground cables at 60,000 volts was placed in experimental operation by the State Railways of Prussia and Hesse between Bitterfeld and Dessau, a distance of 16 miles. There are in use at the present time a high-speed passenger locomotive and a medium-speed freight locomotive, while orders have been placed for a special locomotive capable of operating in either high-speed passenger or moderate-speed freight service. These locomotives are of Allgemeine Elektricitäts Gesellschaft manufacture.

HIGH-SPEED PASSENGER LOCOMOTIVE.

The passenger locomotive, which is illustrated in Fig. 1, is built for a speed of 68 miles per hour. It is driven through connecting rods by means of a single alternating-current commutator motor rated at about 1000 hp on the hourly basis. The speed of this motor is regulated by means of an ordinary contactor controller, which allows the voltage impressed upon the motor to be varied in several steps. Arrangement is also made so as to vary the ratio of turns of the exciting winding and the armature winding in accordance with the speed at which the locomotive is driven. The controller is provided with two cylinders, which can be revolved independently of one another. The position of the upper cylinder determines the torque, and that of the lower cylinder determines the adjustment for commutation. The operation of these two cylinders from the motorman's cab is effected by two hand-wheels placed one above the other. By means of a speed indicator the motorman is enabled to adjust the wheel to the correct position in order to obtain proper commutation under all conditions. The armature of the motor is short-circuited at starting, in order to convert the machine into a motor of the repulsion type under starting conditions.

The motor is placed vertically over an intermediate crankshaft located midway between the two driving axles. The intermediate crankshaft bearings are constructed in four parts, which are adjustable both vertically and horizontally. These bearings being somewhat inaccessible, safety devices, in the form of fusible metal plugs, are placed in the bearings and connected with the main air tank by means of pipes. These pipes lead to an alarm whistle in the motorman's cab. If the bearing should become hot, the plug would melt and the compressed air would operate a warning whistle. The locomotive is equipped with one main transformer, which is located in a ventilated shaft adjoining one of the cabs. The main oil switch is mounted above this transformer in such a way that the switching-in and release handles project into the cab. Two ball-bearing roller devices are used for current collection. The collectors easily follow any alteration in the height of the trolley wire. Use was first made of the bow type of current collectors, but these proved unsatisfactory for high speeds, in that they would not remain in position when under heavy wind pressure. It is reported that the operating results obtained with this locomotive have been exceedingly satisfactory. It exerts a maximum tractive effort at starting of 21,000 lb.

FREIGHT LOCOMOTIVE.

The freight locomotive has been constructed for a maximum speed of 43.5 miles per hour. The locomotive is equipped with a single-phase motor having an hourly rating of 800 hp. The method of regulating the torque of this motor differs from that employed with the motor on the passenger locomotive. The direction of rotation and the torque are varied by mechanically shifting the brushes. The axis of the brushes is moved from the neutral position to one side or the other according to the desired direction of travel, the brushes being shifted by means of a rocker driven by a screw mechanism. Additional torque regulation at high speeds is obtained by altering the impressed voltage by means of a transformer. Good commutation at all speeds is insured by regulating the ratio of the turns in the main windings and in the compensating windings. Use is made of an intermediate crankshaft as is done on the passenger locomotive. However, the motor is not placed vertically over the intermediate crankshaft, but is arranged in such a manner that the driving rods form an angle of 45 deg. with the horizontal.

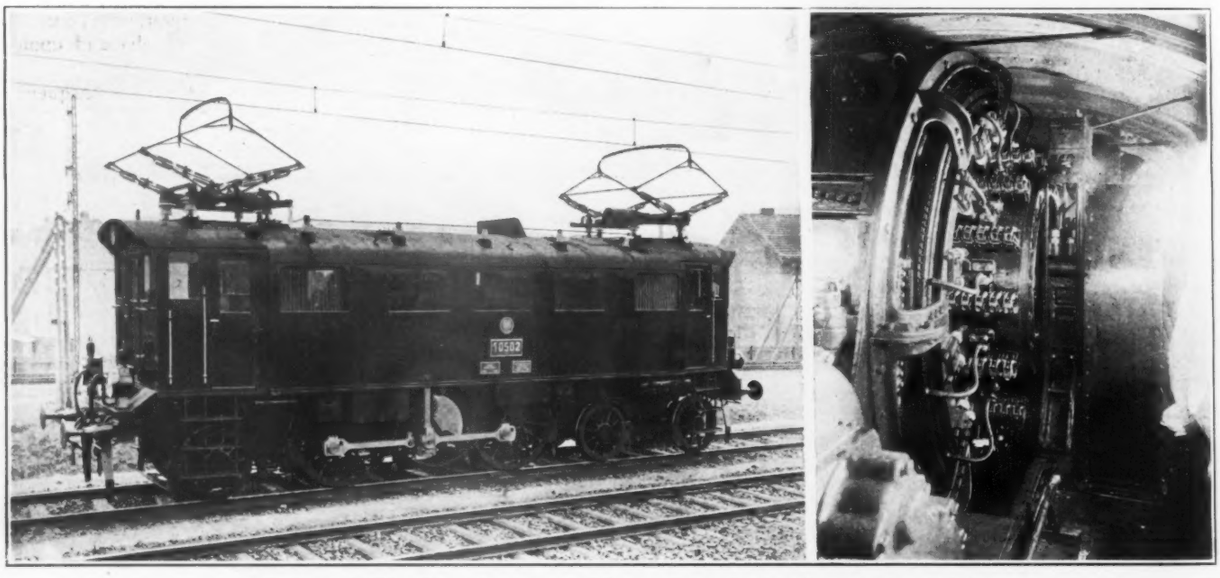


Fig. 1—High-Speed Passenger Locomotive and Single-Phase Commutator Motor.

SPECIAL LOCOMOTIVE.

A third locomotive which is now being built has been designed for drawing express trains at speeds up to 68

miles per hour and heavy freight trains at lower speeds. The locomotive will be equipped with two motors, each having an hourly rating of 900 hp. This locomotive will differ appreciably from the other two designs, both in its external construction and in its system of control. Variation of the voltage impressed on the motor will be effected by an induction-type regulator instead of by a step-by-step regulator. There will be four driving axles arranged to permit the development of the maximum tractive effort. The motors will drive the axles by means of the parallel crank arrangement, the design being such that only one intermediate crankshaft will be required.

OVERHEAD-LINE CONSTRUCTION.

Use is made of a single overhead contact wire of hard-drawn copper wire, operated at 10,000 volts to ground. This wire is held in alignment by the usual catenary arrangement, the messenger cable being of galvanized steel. Special attention has been paid to the insulation of the messenger cables and contact wires. The contact wire is supported at intervals of about 20 ft. by hangers connected to the catenary messenger wire. The catenary bridges are placed about 246 ft. apart. The overhead line is sectionalized about every 3300 ft. The center of each section is rigidly anchored, while the two ends are kept taut by automatic tension devices, so that the supporting wires are under approximately the same tension at all temperatures. For this purpose use is made of tension-regulating weights, which are installed at the ends of the sections. At each catenary bridge and anchor bridge the insulation to ground is provided by two disk insulators placed in series. The brackets which carry the trolley wire are equipped with one bell and one grooved insulator, to secure double insulation from ground. The contact wire is staggered as much as 20 in. from the center line of the track, in order to insure uniform wear of the current collectors.

HIGH-TENSION UNDERGROUND TRANSMISSION.

Energy for operating the railway is received at a substation in Bitterfeld at 60,000 volts, the emf being lowered to 10,000 volts by means of two 15-cycle, single-phase transformers rated at 1800 kva. The energy is generated in a station at Muldenstein, about 5 miles from the Bitterfeld substation. Although the very short distance of transmission would not require a transmission emf higher than the distribution value of 10,000 volts, yet it was considered highly desirable to use an emf of 60,000 volts in order to make investigation with several transmission systems from which a choice will be made when the distance is increased to such an extent as to require the use of the higher voltage. For this purpose there have been installed three independent 60,000-volt, single-phase transmission lines between the generating station and the one substation thus far equipped. One of these is an aerial line and the other

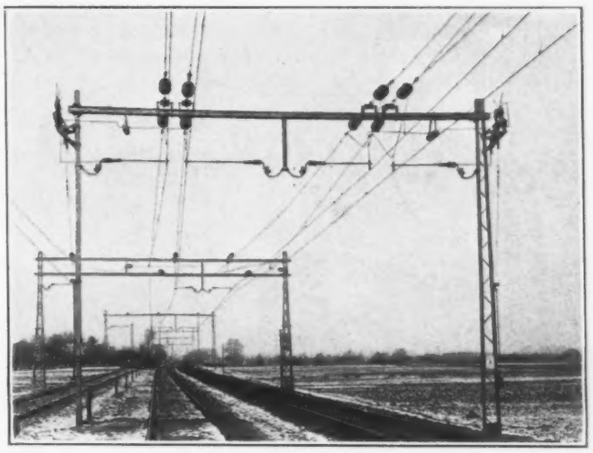


Fig. 3—Section Division on the Main Line.

two are underground circuits. Naturally the greatest interest centers around the underground circuits, which are unique in being operated at the highest voltage ever used commercially on underground cables.

Although delivering an emf of 60,000 volts, each individual cable is subjected to only 30,000 volts, two distinct single-conductor lead-covered grounded cables being used for the two conductors of each 60,000-volt, single-phase circuit. One set of cables was built by the Felten & Guilleaume-Carlswerk company and another by the Siemens-Schuckert company.

The conductors of the Felten-Guilleaume cables are of copper of 80,000-circ. mil cross-section, insulated with prepared paper. The cables were tested to 40,000 volts at 40 cycles. They showed the following characteristics: Insulation resistance, 3450 megohms per km (0.62 mile); capacity, 0.138 mfd. per km; circuit resistance, 0.308 ohm per km.

The Siemens-Schuckert underground circuit consists of

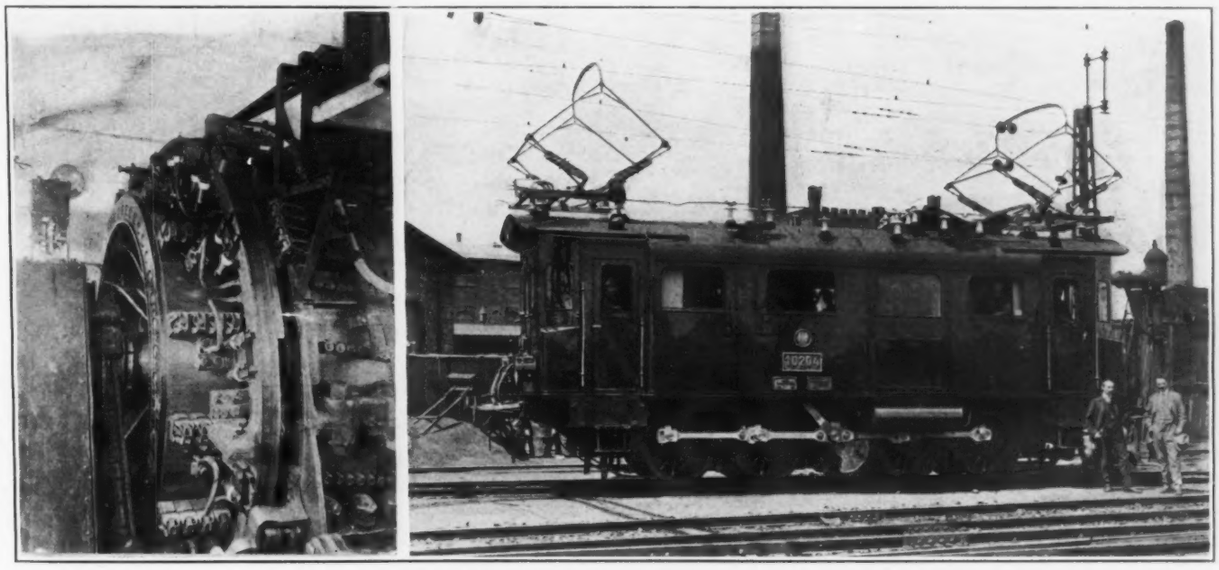


Fig. 2—Single-Phase Commutator Motor and Freight Locomotive.

two single-conductor aluminum cables having a cross-section of 100 sq. mm (197,300 circ. mil, about equal to No. 4-0 B & S gage). The cable is of the lead-covered, paper-insulated type, but with a covering of insulating compound between the paper and the lead sheath and also between the lead sheath and the outer covering of asphalt-impregnated jute fiber. The cable was tested with 50,000 volts between conductor and sheath after completion; this emf corresponds to 100,000 volts between the outgoing and return conductors. The cable has an insulation resistance of 2580 megohms per km, capacity of 0.1695 mfd. per km, and circuit resistance of 0.268 ohm per km.

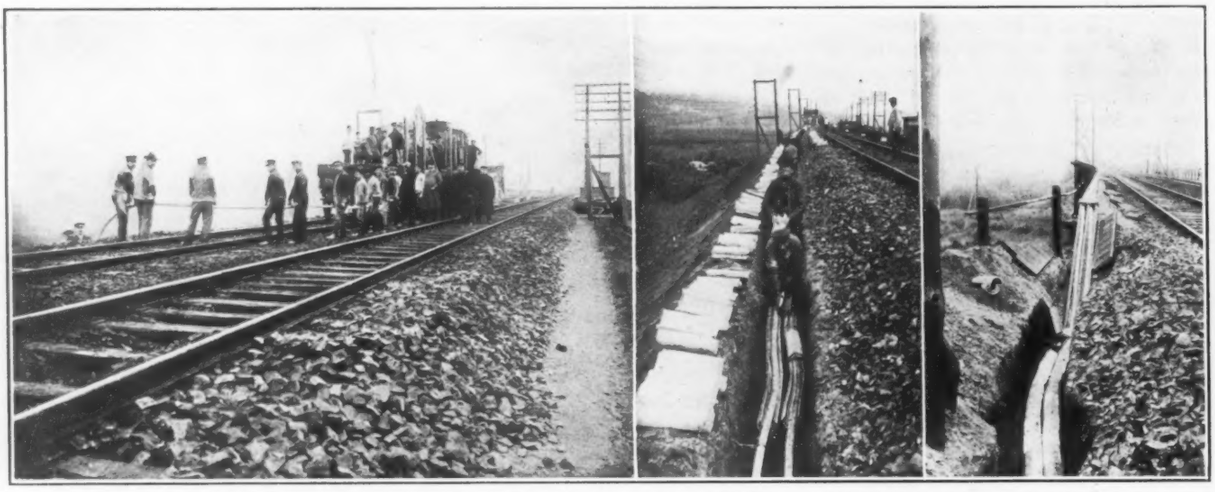


Fig. 4—Method of Laying Cable.

LAYING THE CABLE.

The individual lengths of the Siemens-Schuckert cable varied from 2130 ft. to 2700 ft. An interesting method was employed in laying the cable. The cable drums, weighing about 15,000 lb. including cable, were mounted on railroad flat cars equipped with wooden jacks so that the cable could conveniently be taken to the place where it was to be laid and reeled off as needed. The train was then moved slowly along and the cable was reeled off and lowered directly into the cable trench. Each day two lengths were laid side by side, as the trench could not be left open over night. The trench was dug about 26 ft. deep alongside of the outer track. The cables were laid in sections of two-part conduit clay piping which was filled with sand. This piping was not considered sufficient protection for the cables where installed on the land adjacent to the generating station, and for this reason a layer of thoroughly baked bricks was placed over the clay piping. The cable was carried over the railroad bridges in wooden cases having a packing of tar paper and filled with sand.

Five junction boxes had to be installed in each of the two cables laid in the trench. These boxes were mostly placed in the slope at the side of the roadbed. The junction boxes consist of a cast-iron case with conical ends which were soldered to the lead sheath of the cable. The aluminum conductors were connected by means of clamps which were covered with insulating paper of heavy texture. The junction boxes were then filled with an insulating compound. The joints were made inside of wooden shacks built over the junction places on account of the cold weather, the laying of the cable having taken place in November and December. Two layers of bricks were placed over the junction boxes to protect them from injury.

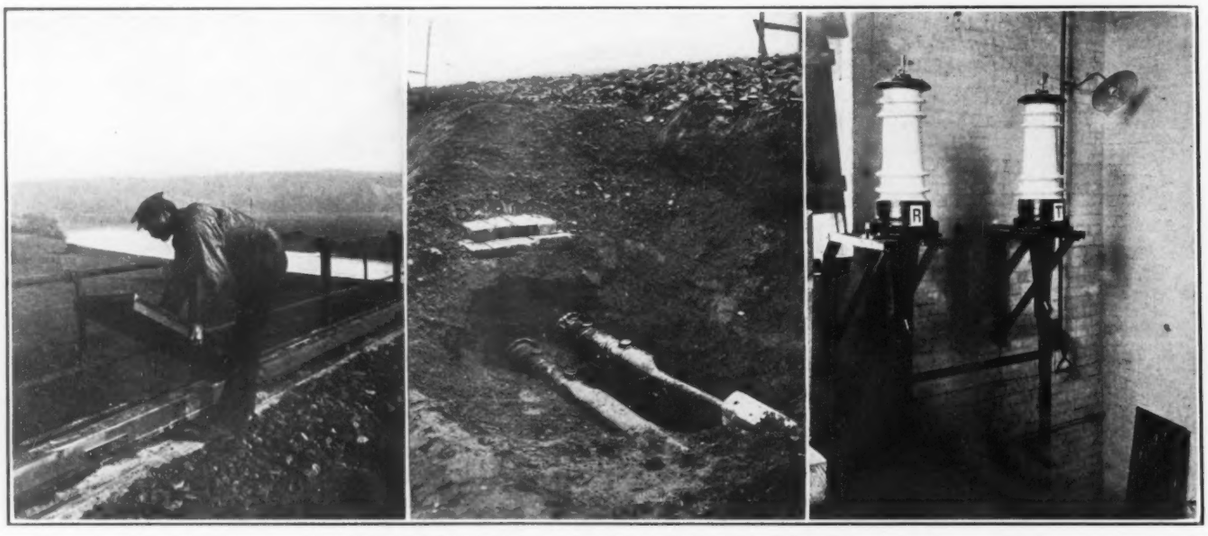


Fig. 5—Cable Protection, Cable Junction, and Pot-Heads.

The places along the roadbed where the boxes were placed are indicated by enameled signs. The position of the cable is shown by indicators along its full length. The indicators consist of inverted cast-iron boxes which are laid almost flush in the ground. On the inside is attached a length of wire cable, and to the other end of this

a cast-iron cross, which is laid next to the cable and which acts as an anchor for the box.

Potheads are installed in the power plant and the substation. They consist of a cast-iron lower part and an upper part of porcelain with a metal cover. The metallic lower part is soldered to the lead sheath of the cable. A brass rod, passing through the cover of the pothead, is screwed onto the aluminum conductor, and to this are connected the conductors to the busbars. The entire pothead was filled with insulating compound after connections were made.

There were two objects in placing the transmission circuits underground, the principal one being the immunity from atmospheric disturbances and the other the desire to hide them from the view of any rioters or invading army in case of war.

OVERHEAD TRANSMISSION SYSTEM.

The overhead transmission line was erected to forestall delays through the possible failure of the underground cable lines and also to determine its influence on neighboring parallel low-voltage circuits. Use is made of both suspension-type and pin-type porcelain insulators and of both wooden and metal poles. The two wires of the single-phase circuit are mounted on either side of the poles in a horizontal plane, while a third grounded wire is placed along the tops of the poles. This wire is connected to all cross-arms and to eight iron plates buried in the earth. A grounding guard ring for protection from destructive arcs is placed around each pin-type insulator. All insulators were tested for punctures up to 100,000 volts and for arcing over during an artificial shower up to 80,000 volts.

SINGLE-PHASE GENERATION.

The station at Muldenstein contains at present only one generating unit, a 15-cycle, two-pole, 300-kw, 3000-volt Siemens-Schuckert single-phase generator directly driven at 900 r.p.m. by a 5000-hp Allegemeine steam turbine. There are at present four Stirling water-tube boilers operated at 125 lb. gage pressure and 375 deg. C. superheat temperature. The completed boiler house will contain four more units of the same type and size.

The railway section now in operation is only 16 miles long, but the plans contemplate the electrical operation of the entire line, totaling 95 miles.

HOW FAR WILL A TROLLEY-CAR RUN?

By Nicholas Stahl.

The drop in trolley-car speed toward the end of a line remote from power house to substation and inadequately feedered is familiar to every rider.

Those conversant with first electrical principles know the speed to be connected in some way with the amount of current passing through the motors and realize that the less the feeder copper the greater the line resistance and ohmic drop outside the motors for a given current through them.

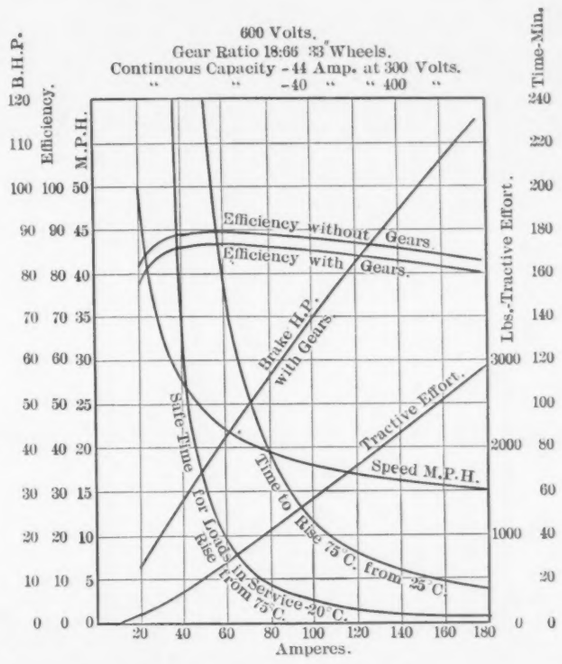
With a given frictional resistance to be overcome the required torque is understood to be proportional to the product of the armature current and the field flux, and hence is roughly proportional to the square of the current with ordinary series railway motors.

The initial question is asked and the following example cited in the hope of bringing out more clearly the nature of the dependence of speed upon feeder-copper capacity and as suggestive of a means of attack upon the broad question of feeder distribution.

The question is, of course, meaningless until certain constants are determined. Let us assume then an ordinary interurban car, weighing 40 tons with its quadruple equipment and average load, runs past the power house at which 600-volt current is fed directly into a No. 3-0 trolley wire and 70-lb. bonded steel rails. No feeders are supplied. Thirty-three-inch wheels are used and a common gear ratio of 18:66. It is supposed that the track is level and straight and that the car on passing the power house has reached a steady speed, which under the assumed conditions and with modern railway motors rated at 60 hp at 600 volts would be about 25.3 miles per hour.

For every 1000 ft. from the power house there is interposed in the circuit 0.0618 ohm of resistance from the trolley wire, or 32.6 volts drop per mile per 100 amp in the circuit, and likewise the resistance added by the rails contributes 3.54 volts drop per mile per 100 amp, or a total drop of 36.14 volts.

The problem of finding how far the car will run without stalling is merely to find from any approved train-resistance formula the stalling torque, which divided by the number of motors on the car gives from a performance curve of the motor the amperes flowing per motor when the motor stops and there is no counter emf. This current multiplied



Operating Characteristics of Motor.

by the motor resistance gives the drop across the motor; the difference between this and the initial 600 volts, divided by the drop per mile for the current flowing, gives the distance to standstill.

A standard train resistance formula is Blood's, which gives resistance in pounds per ton weight

$$= A + BM + \left[C + \frac{D}{T}\right] M^{1.8}$$

where $A = 5.0$, $B = 0.12$, $C = 0.0014$, $D = 35$, $T =$ tons and $M =$ miles per hour. At stalling only the first term is left, or 5 ton x 40 ton total or 50 lb. per motor. The motor curve shown gives this tractive effort at about 12 amp.

The total resistance of the motor in question is 0.41 ohm, or motor drop $= 0.41 \times 12 = 4.92$ volts. The line and rail drop is then $600 - 4.92 = 595.08$. Assuming the full parallel arrangement of the control has been undisturbed, the total current is 48 amp, making the total drop per mile $36.14 \times \frac{48}{100} = 17.35$ volts, and so the distance traveled $\frac{595.08}{17.35} = 34.3$ miles.

Of course, little actual dependence can be placed upon such figures, since the track conditions are entirely ideal and the curve of tractive effort has been exterpolated for the torque sought, but relative figures are often equally instructive. For example, had the more usual No. 4-0 trolley wire been used with the same rails the total drop per mile for 48 amp in line would have been 14.14 volts and the corresponding run to a standstill 42.1 miles, or an increase of 23 per cent nearly.

By a similar procedure and remembering to use all the terms involved in the train resistance formula, two other interesting questions are readily solved; first, what will be the speed at a certain distance from the power house and, second, how far will the car have gone when its speed has become of a certain value?

The foregoing has purposely (and necessarily) taken no stops into account, so that, quite apart from any integrated or root-mean-square current versus speed considerations, a little calculation of this simple sort will frequently throw encouraging or disconcerting light on a proposed feeder arrangement and will obviate propositions like one recently made, which involved on a 600-volt service, for current sufficient to start a car on a level at the end of the line, a rail and line drop of 1625 volts.

Central Station
Management, Policies and Commercial Methods

BOSTON EDISON NEW-BUSINESS RECORD.

Statistics just gathered by the contract department of the Edison Electric Illuminating Company of Boston, Mass., show that the month of October, 1911, was the best in point of new business secured since the company was organized. The total new business connected in the record months of October in the past four years has been as follows, in 50-watt equivalents: 1908, 34,806; 1909, 68,091; 1910, 72,879; 1911, 75,315. In the month just closed 1811 new customers were secured and the installations of 960 customers increased in capacity, compared with 1519 new customers in October, 1909, and 642 increased installations at that time. The figures indicate that the development is along the lines of a greater popularization of electrical service, with a notable increase in the number of small users.

SHORT STRAW CROP PUTS PREMIUM ON BALE SHAVINGS.

The wood mills which have installed electric drive instead of the expensive power obtained from burning their wastes and shavings are this year especially profiting by the demand for baled shavings owing to the short straw crop. As a result of this partial failure a premium is already placed on shavings for bedding purposes.

Those mills which already have electric drive will therefore find a motor-driven baling machine just now an excellent investment. From the central-station standpoint the wood-mill load is a very desirable one on account of its long-hour use and summer load-factor. Mill operators who put in electric drive invariably find that they can sell their refuse at a profit over their electric bills, besides enjoying the freedom from plant operation and the many advantages of motor drive.

THE CENTRAL-STATION POWER ENGINEER BEFORE HIGH-SCHOOL PHYSICS CLASSES.

Much has already been said about educating the public on electrical matters, but the central-station operator who is looking ahead at the problem of popularizing electricity on the scale necessary for its fullest development will find good returns following a little time taken by himself or his motor-drive specialist for one or two talks before the local high-school classes in physics each year. The instructor will, usually, welcome such outside aid, and the students addressed are of an age and training to appreciate the practical subjects handled. The electrical man can give much information on simple circuits, motor applications, heating devices, etc., supplementing the theoretical instruction of the teacher and giving an opportunity for answering many questions which previous lessons have stimulated. The benefit of such missionary work comes later, of course, in the realization by the rising generation of the possibilities of central-station service for light, heat and power. Several large companies are following out this plan with much success.

PRIZE DESIGNS FOR STREET-LIGHTING FIXTURES.

The Municipal Art League of Kansas City, Mo., has offered prizes for the best designs for street-lighting fixtures in order to secure an effective and artistic illumination system of the business streets. The Kansas City advertising committee has obtained an agreement from property owners to install equipment along one block on Walnut Street as a demonstration. Prizes and terms in the contest are as follows: An ornamental lighting standard, 14 ft. high, to provide not less than five lamps, first prize $25, second prize $7.50; an ornamental lighting bracket to be attached to the present steel trolley poles of Kansas City, to be not more than 6 ft. long and provide not more than four lamps, design to include ornamental base for the trolley poles at pavement level, first prize $25, second prize $7.50. Designers are referred to the street-lighting fixtures now in use in Paris, Brussels, Berlin, Des Moines, Los Angeles, Atlanta, Denver and Minneapolis.

Drawings are to be submitted, unmounted, on one sheet, 14 in. x 20 in., with single-line border and plain print lettering and without mark of identification, on or before Dec. 9, 1911.

PUBLICITY CAMPAIGN IN LOS ANGELES.

In connection with the construction of the Los Angeles aqueduct and the development of an elaborate system of electric-energy transmission from plants to be built along the route of the conduit, considerable discussion is taking place locally in regard to the probable market for the output of the aqueduct generating stations. In order to conserve the existing investment of private companies in distributing systems in Los Angeles and secure the utilization of the aqueduct energy without costly duplications and ruinous competition, a publicity campaign is now being carried on in the daily press of the city under the auspices of the principal central-station interests. The situation is being presented to the public by frequent bulletins, known as "Electric Talks," eight of which have now appeared at

intervals of a few days. The bulletins review the early development of electric lighting and motor service in the Los Angeles district, the scarcity of dividends in the pioneer years, former high cost of service in coal-burning stations, present economy of energy generated in hydro-electric plants and supplementary oil-burning steam plants, enormous growth of the physical systems of the present companies, efficiency of the existing distributing apparatus and circuits, and the financial aspects of the proposition to establish a municipal lighting and motor-service business. The evils of competition are reviewed, and the dual plans of a municipal leasing of the present systems of distribution and the sale of electricity to the existing companies for distribution under their present organizations are set forth. About twenty bulletins are to be published, with the object of facilitating a co-operative arrangement within the financial ability of the city for the sale of electricity from the aqueduct plants under conditions consistent with the protection of the existing private investments and the benefit of the general public from the aqueduct project.

ELECTRIC-SIGN CAMPAIGN IN ST. LOUIS.

As a result of a very active campaign carried on by the Union Electric Light & Power Company, of St. Louis, under the direct supervision of Mr. F. D. Beardslee, commercial engineer, there have been a large number of electric signs erected in that city during the last two or three months. The central-station company has been utilizing nearly every possible medium for the purpose of "boosting" the sign business, and at the present rate of progress it looks as though St. Louis will be pretty well covered before the campaign is over. It is said that there are now about 600 electric signs, containing 80,000 lamps, in St. Louis.

A feature of this campaign, and an unusual one, was the publication by the *St. Louis Republic* of Sunday, Oct. 29, of a special eight-page electric-sign section. This contained pictures and articles about the numerous electric signs of the city, based on the "illumination uplift" which has been apparent in that center within the last few years. The average electric sign, it is said, costs the advertiser in St. Louis from $2.50 to $3 a week, and therefore the expense is a moderate one. One of the most elaborate designs illustrated is that of the Illinois Traction System, which will erect within a few weeks a striking sign over its new passenger terminal at Twelfth Street and Lucas Avenue. The central feature of this sign will be a representation of an interurban car and of the block-signal system which is used so extensively on the McKinley lines.

As a result of the great increase in the number of electric signs and the attention which has been attracted by them a movement is on foot to secure a modification of the city ordinance relating to electric signs, which prohibits signs from extending more than 18 in. over the sidewalk. With proper safeguards to secure safety it is thought that this provision may be amended to give a broader scope to the electric signs. It is pointed out that no one ever heard of an electric sign properly supported falling to the ground, and as these features add greatly to the brightness and attractiveness of the city there seems to be some demand for a greater latitude in relation to projecting signs.

PROPOSED SIGN ORDINANCE IN PITTSBURGH.

A sign ordinance recently introduced into the City Council of Pittsburgh would very materially affect the electric-sign business. Every sign and signboard in the city is to be taxed $2, and a bond of $5,000 is demanded to indemnify the city against loss, damage or injury. Violations are subject to forfeits not exceeding $100, and default in payment will result in a sentence of thirty days in jail. It is further provided that before any sign shall be erected a permit must be secured from the Department of Public Safety. In addition to this, the owner must secure within ten days of the erection a maintenance permit, which must be renewed annually.

The portion of most interest to electrical men, however, is the provision which limits the distance any sign not an electric one may project over the sidewalk to 1 ft. Electric signs, however, when vertical may project 4 ft. beyond the building line, and horizontal ones may extend to the curb. If the two sides are exposed to public view, both must be illuminated. No more than two lines of letters are permitted, and each letter must be formed by electric bulbs not more than 4 in. apart and of not less than 4 cp each.

A further provision is that the border beyond the letters shall not exceed 3 in., and no sign shall be more than 2.5 ft. wide. The ordinance also provides that each and every bulb of the electric sign shall be lighted at or before darkness and shall be kept lighted until midnight, at least, on every day in the year, and each bulb thereon shall be renewed by a fresh bulb every time one burns out.

These provisions are very strict, and while in many cases they would be advantageous to the company supplying energy, yet in others they impose such restrictions on the sign owner that it is doubtful whether it would help the sign business. It is very doubtful if the ordinance will pass in its present form.

CHANGES IN ELECTRIC PLANT AT TRINIDAD, COL.

The Federal Light & Traction Company, of New York, has recently come into control of the Trinidad gas, electric light and traction properties and is operating these utilities under a local company—the Trinidad Electric Transmission, Railway & Gas Company. Chief Engineer W. A. Haller is spending some months completing the rebuilding of the main power plant and the installation of new equipment. The storage battery formerly used is now completely abandoned.

The power station when complete will consist of a boiler house, 95 ft. x 100 ft. by 50 ft. extreme height; an auxiliary room for boiler-feed pumps, draft fans, etc., 120 ft. x 40 ft., and the same height as boiler house; an engine-room, 30 ft. x 140 ft., extreme height 40 ft., and a transformer and switchboard room, 40 ft. x 140 ft., extreme height 40 ft. All sections are separately roofed, but communicate through doors, with large trussed opening between engine and switchboard sections. All roofs are of corrugated iron on unprotected steel trusses, spanning from 30 ft. in the engine-room to 140 ft. in the auxiliary room. Cranes are installed in engine and switchboard rooms and all supporting walls pilastered for roof truss and crane supports. The present engine-room equipment consists of a 500-kw, a 1000-kw and a 2500-kw Westinghouse-Parsons three-phase, 2300-volt turbo-generator units, with induction motor-driven Le Blanc jet condensers for the smaller units and turbine-driven Le Blanc condensers for larger units. The 2300-volt, 100-hp induction motor and one 100-hp Westinghouse marine engine drive the exciter units. Space is provided for two additional turbine units. The floor, its supports and its foundations are of reinforced concrete.

The switchboard comprises direct-control panels for generators, 2300-volt feeders and rotary converters with trolley feeders. Remote control panels are used for 22,000-volt oil switches, besides manual control on feeder switches. The switchboard-room is of fireproof construction with barriers for oil switches and separate wireways for different sets of feeders. The arresters are of the aluminum-cell

type on the high-tension feeders. The water-cooled, oil-insulated station transformers are isolated by concrete barriers from the switchboard division and arrangements are provided for rapid draining. They are at all times visible to the switchboard operator.

The boiler-room is provided with a coal and ash conveyor and a coal crusher, each operated by a 20-hp, 440-volt induction motor controlled from the boiler-room floor. Slack or mine run bituminous coal from neighboring coal mines is the fuel. The bunker storage capacity in twelve steel units under the roof of the boiler-room is 300 tons, hoppered discharge being provided to stokers. Four new 600-hp Parker water-tube boilers in two banks, equipped with Green stokers, engine-driven, are installed at the south end of the boiler-room. The old equipment on the north, which will also be provided with stokers, consists of four 250-hp Franklin and four 300-hp Taylor-Altman water-tube boilers, all with independent steam connections. Sturtevant engine-driven fans and self-supporting steel stacks handle furnace gases. The plant is wired in iron conduit, equipped with metal waste cans, metal lockers, tetrachloride fire extinguishers and represents the best steam power house construction in the Rocky Mountain region.

In addition to energy for local lighting and motor service and a traction line not yet self-supporting, the company will distribute energy to the coal-mining tipples, hoists, etc., which are very numerous and provide a very desirable and permanent character of load, partly for twelve hours per day and partly for constant duty.

SOME SELLING POINTS.

Men who sell electricity, like all other salesmen, are the recipients of much advice. Some of this advice is good, some rather platitudinous. To the former class, it is thought, belong the hints given in a paper entitled "Some Considerations Involved in Selling Light and Power," read by Mr. Egbert Douglas, sales manager of the Milwaukee Electric Railway & Light Company, at a recent meeting of the Milwaukee Company Section of the N. E. L. A. A few of these suggestions are given in the following paragraphs:

"The sale of electricity, while it is measured in units, is not like the sale of unit articles. It is distinctly a continuous service to go on year after year."

"There is no mystery about the arts of applied electricity, but there is a good deal of fogginess in the minds of people about them. It is up to us to clear this away."

"Remember that the susceptibility of man to new impressions is a variant, rapidly diminishing in its power with advancing years. So do not be discouraged with any 'prospect' who is slow coming over."

"If there is doubt as to the advisability of electrification, the salesman should carry his doubts to his superior, and if, after an office consultation, it is deemed that electrification is not an economical move, then the customer must be told so plainly. Your company wants no dissatisfied customer on its lines. While there are conditions prevailing in some plants where the purchase of energy is inadvisable, they are mighty few."

"In our hurried life there is a constant temptation to be rude and curt with people, particularly when the probability of future dealing with them is small. Consequently busy employees are prone to show scant courtesy to the public. Thus the industrious meter-reader may be interviewed by a customer with a definite complaint. If the meter man curtly informs him, 'That is not my business; you must see the company; my job is to report the meter reading,' the customer will have just reason to feel angry. The complaint should be received courteously and reported, but no effort should be made to adjust the matter."

"Where the service is sold in competition it is necessary to know the quality of the competitive service thoroughly well."

"Questions will arise as to the merits of respective propositions, and the salesman must be on his guard against 'knocking' the competitive commodity or service. It has its good points, or it would never have been adopted or come up for consideration. In discussing a competitive proposition the salesman should dwell upon the superior merits of the service he sells and endeavor to fill the prospective customer's mind with his viewpoint. Never begin a discussion of competitive service, nor allow yourself to be drawn into a discussion of it, except under pressure. The discussion, being forced, should be carried on with the kindliest expression toward the competitive point of view. Endeavor to put yourself in the position of the prospective customer. Frequently a prospective customer will say, 'Now, Mr. Jones, you seem to know all about both of these propositions. Would you install electric service yourself if you owned my factory?' Then comes the opportunity for the salesman to 'get in his work.' Rapidly he puts himself in the position of the factory manager and suggests again the advantages of his proposition for his plant."

"Factory lighting is not attractive business. It is a peak on our winter peak and does not usually exceed 500 hours' use per year."

"One of the most important things for a salesman to look out for when he gets a contract is to get it 'clean,' so that it becomes unnecessary to make several trips back and forth to the customer and unnecessary to confer about it with other men in the company. The contract simply takes its routine course through the office. That is what the system is for."

"Be on your guard against leaving a customer with erroneous impressions of what he is purchasing."

"When a manufacturer gets a 'black eye' in a given territory, due to poor product or improper selling tactics, he may withdraw from that territory and begin his selling effort in a virgin field. The central station cannot do this. Our customers are our neighbors, and we have to live on terms of friendliness with them forever. Quarrels, misunderstandings, rude treatment and unfair tactics must be scrupulously avoided."

CENTRAL-STATION SERVICE AT CHEYENNE.

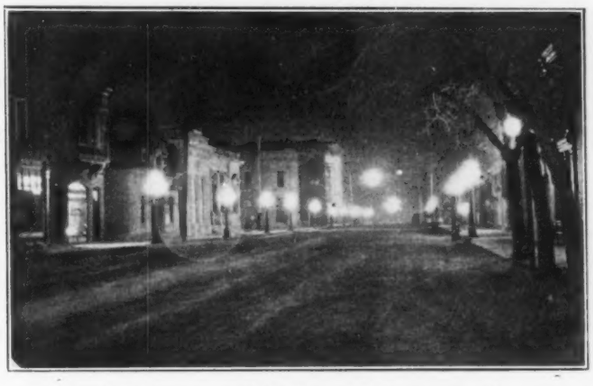
Electrical service is rapidly becoming popularized at Cheyenne, the capital city of Wyoming, under the management of interests identified with the Northern Colorado Power Company. Cheyenne is a typical Western city in close touch with the great grazing industry which forms the chief occupation of the State, and it is an important railroad and distributing center of about 11,000 inhabitants, being located on the main line of the Union Pacific system between Omaha and the Pacific Coast, about 106 miles north of Denver. Four miles south of the city is located the important military post of Ft. Russell, whose population approximates 4000, representing practically every branch of the army service.

Central-station facilities in Cheyenne and Ft. Russell are supplied by the Cheyenne Light, Fuel & Power Company from a steam generating plant located about ¼ mile from the business center of the city, at the intersection of Reed and Seventeenth Streets. At present there is no connection with the lines of the Northern Colorado Power Company, but with the extension of the latter system in connection with electric irrigation work in the district north of Greeley and Ft. Collins it is probable that the two systems will be brought into operating contact. The existing plant in Cheyenne was purchased about four years ago by the present interests, and while the station contains no

direct-connected steam generating equipment, it illustrates how an old plant can be improved and utilized in extending a successful service.

The plant is burning Colorado lignite coal costing about $2 per ton delivered at the boiler-room, the heating value of the fuel being 9500 thermal units per pound. The station is at an altitude of about 6000 ft. above sea level, and is equipped with six water-tube boilers, two units being 600-hp Franklins and four Babcock & Wilcox boilers having a total rating of 750 hp. The operating steam pressure is 160 lb., without superheating. Natural draft is employed, and there are three stacks of steel in service, one being 66 in. in diameter and 175 ft. high and the other two 60 in. in diameter by 125 ft. high each. The smaller stacks are provided with three sets of guys each and the large stack with five sets, ½-in. and ⅝-in. stranded steel cables being used for the purpose on account of the high winds prevalent in Cheyenne. Hand firing is employed, and feed water is purchased from the city mains. A 1000-hp Cochrane open feed-water heater is in service, and three feed pumps are installed, all being of Smith-Vaile manufacture. One pump is large enough to handle the service of the entire plant, the other two being each of half the capacity of the former.

The electric generating equipment is partly belt and partly motor driven. The service of the station includes the supply of direct current at 550 volts to the Cheyenne



Night View of Capitol Avenue, Cheyenne, Wyo.

Electric Railway Company, which operates twenty-four hours per day and consumes an average of about 1700 kw-hours in that period; lighting service within the business center of the city from a network of Edison three-wire, 110-220-volt mains; street lighting, three-phase, 2300-volt lighting and motor service throughout the entire district, and exhaust steam-heating supply within the center of the municipality. The normal service of the street railway company is handled by four cars, from twelve to fourteen cars being operated at times of heavy travel. The railway system imposes a maximum instantaneous load of about 275 kw, and about 10 miles of track is covered by the car service. The steam-heating supply is delivered to the city through a 14-in. main leading from the station to the center of distribution, the returns being brought back to the plant by a 6-in. main. A maximum steam pressure of about 5 lb. is required in the coldest season. In general, the steam-heating service covers all the principal buildings within a radius of 1 mile from the station, including hotels and mercantile establishments. The company's rates for steam heating have not as yet been finally established.

The engine-room equipment includes five Corliss engines of the simple, non-condensing type, four being rated at 300 hp each and the fifth at 750 hp, and also a 250-hp high-speed Chuse engine and a similar 150-hp Ideal engine. The electric generating apparatus consists of five 2300-volt alternators of belted type having a combined rating of 1200 kw, delivering three-phase, 60-cycle current; two 125-volt, 45-kw generators, and one 75-kw, 250-volt generator operated on the Edison three-wire system; two 55-kw, 125-volt generators directly driven by a 125-hp, 2300-volt synchronous motor; and for the railway service one engine-driven, 250-kw, 550-volt direct-current generator and two motor-driven synchronous generators having a total rating of 160 kw. Two steam-driven exciters having a combined rating of 105 kw are also in service, the engines being of Erie-Ball and Westinghouse make. The plant burns from 30 tons to 80 tons of coal per day, according to the season, and is operated by a total force of twelve men, divided into three eight-hour shifts per day. The shifts in the fire-room are even, but those in the engine-room overlap. The output of the plant is measured and controlled at a switchboard aggregating fourteen panels of dark-finished marble. The coal consumption is about 8 lb. per kw-hour, including steam heating.

The street-lighting service is handled by 4-amp magnetite arc lamps and by special ornamental post lighting in the center of the city. About 105 magnetite lamps are in service, two fifty-light constant-current transformers and mercury-arc rectifiers being installed at the station. The company has obtained a maximum of 292 hours burning per trim and a tube life from the rectifiers of 3000 hours, an unusually long service in each case. The ornamental lighting, which is illustrated in the accompanying illustration, consists of an installation of eight iron posts per block, the posts being set at the edge of the curb and carrying in each instance one 60-watt and four 40-watt multiple tungsten lamps which burn daily until 11 p. m. The 60-watt lamps are installed at the top of the posts and are about 12 ft. above the sidewalk, the smaller lamps being 10 ft. above the walk and hung at right-angled axes in a horizontal plane. Translucent globes of spherical shape surround each lamp. Energy for the ornamental lamp service is taken from the company's 110-volt secondary alternating-current network, and the price charged for the service is $3.75 per cluster per month. The standard block is 280 ft. long and four clusters are installed on each side of the street, the cost of the service being defrayed by abutting merchants who own the posts. About 110 clusters are now in service and twenty-five additional units are shortly to be installed. The ornamental lighting is switched in and out of service by the company's patrol, and the regular magnetite installation is made at street corners without interference from the tungsten clusters. The magnetite lamps used replace 550-watt direct-current open-arc lamps. The company is also planning to install about twenty-five series-tungsten lamps of 100-watt rating in the centers of alleyways between parallel streets to improve the illumination of these minor passageways.

Service at Ft. Russell is supplied over a three-phase, 2300-volt line of No. 4-0 copper connecting the steam plant of the company with a substation owned and operated by the government. The winter weak load of the fort is about 500 kw and the maximum energy consumption per month is about 50,000 kw-hours. The voltage of the fort feeder is controlled by a booster regulator at the power station. An extensive installation of motors in the fort operates machinery in the repair shops, laundry and other departments. A large amount of lighting service is also required at the fort.

Since the present management assumed control of the Cheyenne plant the station has been improved by the lengthening of the larger stack about 50 ft., thereby increasing the capacity of the boiler plant by over 150 hp; by the rewiring of the switchboard to secure greater simplicity of operation in times of emergency; by the installation of new governors on the engines to provide for the successful operation of belt-driven alternators in parallel, and by the determination of a new location for the feed-water heater at a height about 15 ft. above the feed pumps,

thereby providing for the delivery of water at a higher temperature at the boiler intake and avoiding the breakage of pumps through the accumulation of vapor.

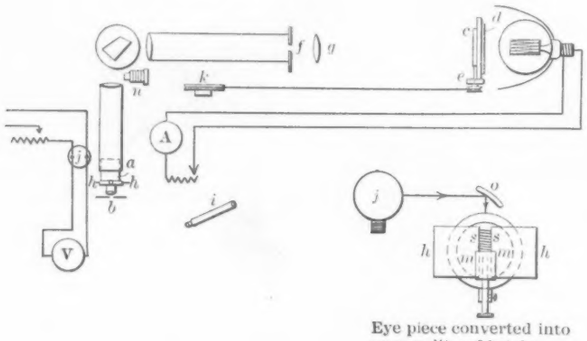
The company's regular commercial lighting rate is 10 cents per kw-hour for mercantile houses, the residential rate being 12 cents. The rate for electric power service is 5 cents per kw-hour plus a demand charge of $1 per horse-power per month. Sign and window lighting is carried on a flat-rate charge, netting the company about 5 cents per kw-hour. The motor service in Cheyenne is mainly of the smaller power type, although the company supplies energy to a brickyard just outside the city proper, the load being of the long-hour type of business and giving an average load on the plant of about 100 hp. Mr. A. G. Langenbach is local manager of the Cheyenne company, reporting to Mr. C. H. Williams, general manager of the Northern Colorado Power Company, Denver, Col.

Wiring and Illumination

THE DEPENDENCE OF VISUAL ACUITY ON THE WAVE-LENGTH OF LIGHT.

By M. Luckiesh.

The ability to distinguish detail depends very largely upon the spectral character of the light which enters the eye. This is due to the fact that the eye is not achromatic. It has been shown by Dr. Bell[1] and further substantiated



Eye piece converted into an equality of brightness photometer.

Fig. 1—Arrangement of Apparatus.

by the writer[2] that monochromatic light has greater defining power than light having an extended spectrum. The region of the spectrum having the greatest defining power is not well established. Mr. J. S. Dow[3] measured the acuity in light from an incandescent electric lamp through a signal green glass and a red glass and arrived at the conclusion that the blue-green end of the spectrum seemingly shows superior defining power for near vision. Mr. S. W. Ashe[4] used red, green, blue and clear glasses with an incandescent electric lamp as a source. He found acuity less for the red and increasing in the order—green, blue and clear glass for the same illumination. The spectrum through clear glass extends presumably over a greater range than the colored lights; therefore, owing to the chromatic aberration of the eye the acuity should be less if there were no other factors which largely influence the defining power of the light. According to Macé de Lépinay the more refrangible portion of the spectrum is less defining than the red region. Others have investigated the question, but to the writer's knowledge none has used monochromatic light of equal intensity throughout the spectrum.

Owing to the conflicting results mentioned and the fact that in most of the previous work the spectral character of the lights used is not stated, it seemed of interest to determine the defining power of various regions on the spectrum. In order to eliminate as far as possible the chromatic aberration of the eye a narrow portion of the spectrum was used, the light which entered the eye being therefore practically monochromatic. A diffraction spectrum rather than a refraction spectrum is to be preferred on account of the character of the dispersion of a prism. However, it is easier to obtain an intense spectrum by the use of a prism, and on account of the low luminosity values of the extremes of the spectrum it is necessary to start with the highest possible intensity.

The apparatus used by the author is shown diagrammatically in Fig. 1. A Hilger constant-deviation spectroscope was used and the various parts of the spectrum were viewed consecutively through the eye-piece, *a*. The width of the eye-piece slit could be varied at will by means of the slides *h h*, and a very narrow portion of the spectrum could be viewed. The Ives acuity object *c*, described in the *Electrical World* for April 14, 1910, was illuminated by a 500-watt tungsten lamp in a parabolic reflector. From this an illumination of 1700 ft.-candles was obtained at 1 ft. from the tip of the lamp. The light was directed on a ground glass *d* in front of the acuity-test object. The acuity object consists of two black line gratings placed face to face. When these are revolved relative to each other on axes perpendicular to their plane faces interference bands are obtained of varying width, depending upon the angle of relative displacement. The lines are always equal in width to the transparent spaces and therefore the total flux of light is constant regardless of the relative displacement of the two gratings. By revolving the drum *e* the width of the lines can be decreased until they become too small to be distinguished. These lines were focused on the collimator slit *f* by the lens *g*. The drum was actually turned by means of a pulley and belt, *k*. The position of the drum was read by means of the telescope *i*. These conveniences were added in order to eliminate the distraction arising from undue shifting of the head or body in taking observations. The drum readings are very approximately proportional to acuity. In the eye-piece there is a pointer, normally used as an index when the spectroscope is used for determining wave-lengths. On this pointer was cemented a small piece of magnesia-coated cardboard, which was illuminated by the light from the lamp *j*, reflected from the small mirror *o*. This cardboard formed one-half of the field of an equality-of-brightness photometer. The shape of the field is shown in enlarged detail in the lower right-hand corner of Fig. 1. *SS* represents the portion of the spectrum being viewed. Across this are seen the lines of the test object when the drum *e* is in such a position that the lines are coarse enough to be visible; *mm* shows the magnesia surface, whose top edge is inclined away from the observer, enabling it to receive light from the mirror *o*. The lamp *j* was all-frosted, producing, therefore, an even illumination on *mm*. The normal focusing distance for the writer's eye is about 14 in.

The procedure was as follows: The voltage of lamp *j* was set at a value which gave the desired illumination on the magnesia surface *mm*. This voltage was kept constant throughout one set of observations. The illumination on the test object was varied by varying the current through the 500-watt lamp. With the wave-length drum *n* set as far as practicable toward the extreme short-wave end of the spectrum and with a constant voltage on the comparison lamp several settings were made for equal brightness by varying the current through the 500-watt lamp. Current readings were noted for each setting and the mean value was used while the acuity readings were obtained. During

[1] *Elec. World*, May 11, 1911.
[2] *Elec. World*, Aug. 19, 1911.
[3] London *Illum. Eng.*, Vol. 2, p. 233.
[4] *Elec. World*, Feb. 25, 1909.

the settings for equal brightness the drum *e* was so turned that the lines of the test object were too small to be visible. The lamp *j* was extinguished while ten acuity readings were made by revolving the drum *e* until the lines just disappeared. Fatigue was eliminated as far as possible by resting the eye for some time after taking a number of observations at each wave-length and by starting at different points in the spectrum. A 2.5-mm artificial pupil was used.

The data obtained in this manner are shown in Fig. 2 by

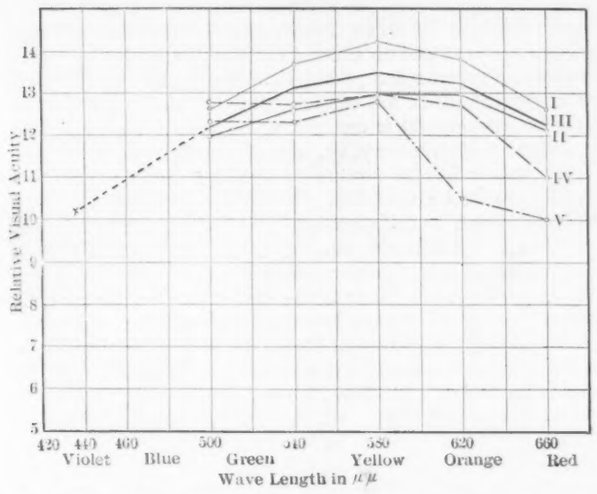


Fig. 2—Variation of Visual Acuity with Wave-Length of Light.

the curves which extend from 500 μμ to 660 μμ. The ordinates are proportional to visual acuity. The illumination on the magnesia surface was 4.2 ft.-candles. The resultant brightness was somewhat lower than that due to an illumination of 4.2 ft.-candles on a white surface, owing to the absorption of the eye-piece lenses and the 2.5-mm pupillary aperture. The writer obtained many curves of the same general character as I and II; however, they always fell within the limits of these two curves. Curves I and II were obtained in the morning and afternoon, respectively, of the same day, illustrating the fact that visual acuity is quite a variable function. Curve III is a mean curve for the writer's eye. This was plotted from mean values obtained by averaging about fifty observations at each point in the spectrum. These observations extended throughout a period of two weeks. Curves IV and V are those obtained by two other observers. They represent mean values of only ten observations at each point.

For extending the results into the violet region of the spectrum the best source available is the mercury-vapor lamp. A number of acuity readings were taken for the three bright lines 436μμ, 546μμ, 578μμ (double). These results are shown in Fig. 3. Curve VI was obtained by the writer and curve VII by the observer who had obtained curve V. The absolute values of the visual acuity for points on curves VI and VII are approximately the same as for the same points on the curves shown in Fig. 2. Owing to a slight change in the apparatus the constants which reduce the ordinates of Figs. 2 and 3 to visual acuity differ slightly. If the writer's data obtained in the extreme blue end of the spectrum are reduced to fit his mean curve, III, it will extend the mean curve as shown by the dotted line.

It was at first thought that the difference in focus for red and blue rays would cause appreciable difference in the acuity settings if the lines were not focused at each point in the spectrum. This was tested out in the first part of the work by focusing the lines for red rays and taking acuity readings throughout the spectrum without refocusing. Next the lines were focused for blue-green rays (500μμ) and acuity readings taken. Finally the eye-piece was adjusted at each station throughout the spectrum and acuity readings were taken. In the three cases the same general result was obtained as far as could be determined. Of course, the natural fluctuations of the acuity function are so large that the possible effects due to difference in focus might have been masked. Throughout the work, however, care was taken to focus the lines at each station except in the series just described.

Justification for using the equality-of-brightness photometer is found in the fact that throughout a wide range of illumination visual acuity varies much more slowly than brightness. A large error in brightness settings would therefore be necessary to introduce appreciable change in the visual acuity measurements. The relative changes of acuity and brightness as determined are shown in the accompanying table. The unit of relative brightness is the

VARIATION OF ACUITY WITH BRIGHTNESS AT DIFFERENT WAVE-LENGTHS.

Wave Length in μμ.	Relative Brightness.	Relative Acuity.*
660	1.00	1.00
	.25	.85
620	4.00	1.05
	1.00	1.00
	.25	.93
580	4.00	1.05
	1.00	1.00
	.25	.95
540	4.00	1.08
	1.00	1.00
	.25	.88
500	4.00	1.08
	1.00	1.00
	.25	.82
	1.00	1.00
	.25	.83

* The values of relative acuity in the last column are comparable only with those in the same group. Groups cannot be compared with each other.

illumination used throughout the work. It would appear from the data of the table that for equal variations in brightness visual acuity varies more rapidly at the extremes of the spectrum than it does in the middle region. At 580μμ a decrease in visual acuity of only 5 per cent is obtained when the brightness is decreased 75 per cent,

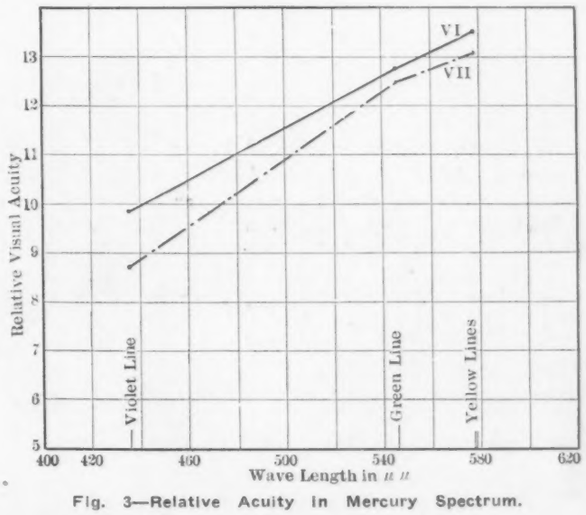


Fig. 3—Relative Acuity in Mercury Spectrum.

while at 436μμ the same change in brightness is accompanied by a 17 per cent change in visual acuity. In curve VII, Fig. 3, the brightness at 436μμ must be increased several hundred per cent in order to obtain the same acuity as at 580μμ. The data presented in the table are subject to the limitations necessarily imposed by the fact that each value of relative acuity was obtained from a mean of only ten readings by one observer. However, the data are sufficiently reliable to show that variations in acuity throughout the

spectrum cannot be considered due to errors in brightness measurements. Aside from the above argument, it might be said that the writer obtains at ordinary illumination practically the same results by the flicker and equality-of-brightness methods, and settings made with the latter method are quite consistent. The other observers have had experience in heterochromatic photometry.

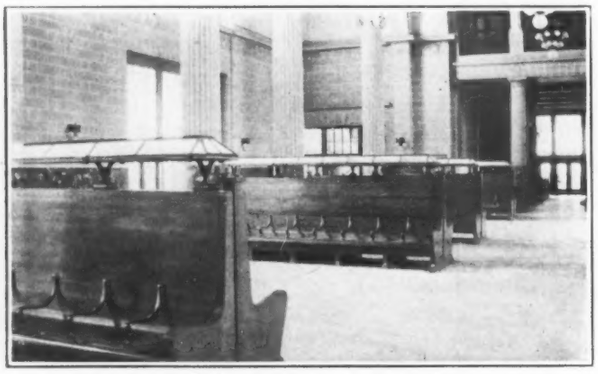
In drawing conclusions more weight is given to curve III, which is a mean curve of several taken under identical conditions so far as they were under control of the observer. The curves obtained by the two other observers, while irregular owing to the fewer observations, show the same characteristics as shown by curve III. It is quite evident that visual acuity depends not only on the spectral character of the light, but also on the wave-length. The extremes of the visible spectrum show a lower defining power than the middle region, the maximum acuity appearing to be in the yellow region.

The writer realizes that the data presented are incomplete; however, the work was unexpectedly interrupted and postponed for an indefinite period, so that it was thought advisable to present the data which had been obtained. The investigation should be extended throughout a wide range of illuminations and with a number of observers.

The writer's thanks are due Dr. Herbert E. Ives and Dr. A. G. Worthing for their assistance in making some of the readings.

ADVANCED TYPE OF WAITING-ROOM SEAT LIGHTING.

The lighting of seats in the waiting-rooms of steam-railroad stations is one of the most neglected details of modern illumination practice, and not a few railroad terminals and way points otherwise admirably equipped have failed utterly in the matter of providing comfortable reading facilities. As shown in the accompanying photograph, the new Santa Fé station at Houston, Tex., constitutes a notable exception to the foregoing condemnation. In the main waiting-room of this building each seat is provided with an installation of twelve 16-cp incandescent lamps mounted on the under side of an inverted trough of translucent glass and located about 5 ft. from the floor level. The glassware and lamps are carried in a neat metal frame supported on short posts attached to the top of the seat back, and the shape of the reflecting surface and location of the lamps in a horizontal row centrally above the top of the seat backing enable a single row of lamps to provide light for the readers on each side. Each seat has eight compartments on each side, so that each row of twelve lamps provides lighting facilities for sixteen persons, in addition to the facilities for general lighting furnished through the aisles and main passageways of the waiting-room by overhead fixtures. The absence of glare is most striking, no less so than the comfort with which the traveler may read while waiting for the arrival and departure of trains.



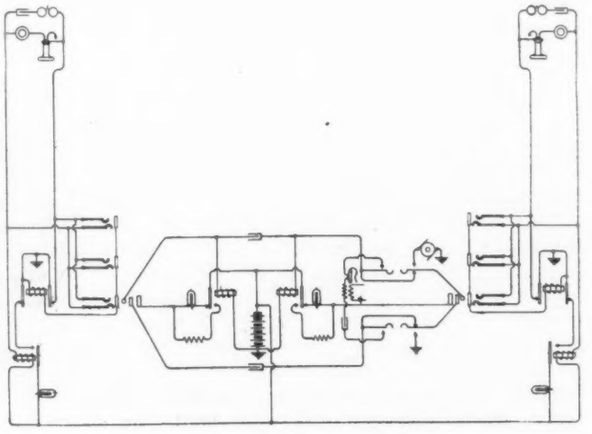
Seat Lighting at Santa Fe Station, Houston, Tex.

RECENT TELEPHONE PATENTS.

NEW CIRCUITS.

In trunking between two exchanges where one-way trunks are used and an order circuit is provided over which trunk assignments are passed each trunk line must be provided with certain automatic signals so that its condition may be known by the controlling operator. These signals are absolutely necessary, because this controlling or switching operator has no means of listening upon any of the trunks to note its condition. One of the necessary signals is a lamp which indicates when the desired subscriber has answered. This is the ringing signal, as when a ring is responded to this signal remains extinguished throughout the connection. Another is the disconnect signal, showing that the distant operator has disconnected from the trunk. A third signal is known as the guard and serves in case of momentary confusion, as it shows when the distant end of the trunk is being held while the near end has been taken down. It is this signal which guards against a reassignment of such a trunk. For a long time it has been customary to combine two of the signals in the same lamp, the interpretation depending upon whether the trunk is connected or disconnected at the controlling end. Common practice combines the disconnect and guard. Mr. A. D. T. Libby, of Elyria, Ohio, feels it better to combine the ringing and guard. He has therefore designed and patented trunk circuits to accomplish this. His patent is assigned to the Dean Electric Company.

A patent granted to Mr. C. S. Winston, of Chicago, and assigned to the Kellogg Switchboard & Supply Company, describes a circuit system for a three-wire central-energy system. Cut-off and line relay are provided for each line,



Central-Energy Telephone System.

but the former severs the line lamp circuit but leaves the line relay connected. The cord circuit has a single supervisory relay, which in association with the line relay forms the battery-feed circuit. The diagram shows the details of the arrangement.

NEW APPARATUS.

A receiver with sheet-metal shell is the subject of a patent issued to Mr. W. W. Dean, of Elyria, Ohio, and assigned to the Dean Electric Company. The specific feature is in the upsetting of the metal of the cap and body pieces where these are to meet so that there will be sufficient thickness of stock to permit of threading.

The patents granted to Mr. A. A. Jahnke, of Richmond, Cal., describe two transmitters. One is the usual type of transmitter save that it is designed for high currents and must have cooling devices. The electrodes are therefore made hollow and a circulation of liquid is arranged through them. The body wall of the granular button is of porous substance, and it at the same time serves as the inner wall of a hollow annulus. The space within this annulus is filled with liquid of a volatile nature, the fumes of which pass through the annulus to cool the granules. The second transmitter is of novel principle. The diaphragm drives the slide of a three-way cock which is arranged at the juncture of three liquid-conveying ducts. A high-resistance liquid approaches the cock in one duct. A highly conducting liquid approaches through a second duct, while the third duct conveys away the mixture. A conducting wire reaches almost to the cock in the first and third ducts. The cock is so arranged that the high-resistance liquid supply is reduced as the low resistance is increased. Thus the conducting path between the two wire terminals is varied in resistance to correspond to the vibrations of the diaphragm. The above patents are assigned to the National Wireless Telephone & Telegraph Company.

Mr. E. L. Persons, of Concord, N. H., is the inventor of a receiver support. An L-shaped arm is arranged so that if the receiver, held at the end of one arm, be pressed back by the ear of the riser, the short horizontal arm will throw the switch springs of the telephone set.

LETTERS TO THE EDITOR.

Visual Acuity and Light of Different Colors.

To the Editor of Electrical World:

SIR:—I have read with interest Mr. J. S. Dow's contribution on "Visual Acuity and Light of Different Colors," and your editorial in the issue of the *Electrical World* for Oct. 14, 1911, in which are suggested explanations of the difference in the results obtained by various observers in the work published by the writer in your issue of Aug. 19, 1911.

Mr. Dow calls attention to a well-known fact that for very near vision it is generally possible to focus the eye for blue rays while much difficulty is experienced in attempting to focus the eye for red rays. The reverse is true for distant vision. While this is true for extremely large and small distances of vision, differences in the ease of accommodation for red and blue rays become less marked for vision at intermediate distances. In fact, at a distance of 1 m, at which the writer and the two other observers viewed the test object, no noticeable difference in the ease of accommodation for red and blue rays appeared and none of the observers has experienced an abnormality in his power of accommodation. The particular results of the three observers referred to in your editorial were obtained with lights of exactly the same hue and would therefore come to a focus at the same point, thus eliminating any effect due to difficult accommodation. If lights of different color had been compared, the method of procedure would have tended to eliminate any difference in the ability to focus the eye for rays of different wavelength. The eye was focused on the lines of the test object and the lines were quickly reduced in size until they became invisible. This operation occupied but a very few seconds, and if the eye was fixed on the lines the reading was taken before the eye had time to relax.

The writer does not wish to appear as belittling Mr. Dow's remarks; however, in the work in which one observer obtained far different results from those of the writer and another observer differences in focus cannot account for the different results, because the focal planes of the two lights were identical. Mr. Dow's remarks apply when comparing lights of different color, although a method of procedure may be adopted which will largely eliminate the difficulty.

It appears to the writer that a satisfactory explanation of the differences obtained by the three observers is to be found, as suggested in the original paper, in the fact that the eye, having a dispersive power only slightly greater than water, forms an optical system tending toward achromatism when combined with a concave crown-glass spectacle lens. While it is true, as Dr. Bell has called to our attention, that the dispersion of the lens of the eye is near that of crown glass, the dispersion of the *total* eye system is only slightly greater than water.

More recent work of the writer* has shown—as far as the limited results can be accepted—that for near vision (14 in.) visual acuity is a maximum in the yellow-green region of the spectrum and falls off considerably for the blue and red rays. This work was done with practically monochromatic light of equal brightness for the various regions investigated. The difference in the ease with which the eye accommodates for different colors was carefully considered by the writer throughout the work, and the conclusion was reached that under the conditions of the experiment it was of little consequence. This conclusion was reached by determining the visual acuity in various parts of the spectrum with the eye-piece refocused at each point and then obtaining similar sets of data by focusing the eye-piece at only one point, making the readings in the other regions without readjusting the eye-piece. On comparing the data no consistent difference was found; that is, in all cases a maximum of acuity was found in the yellow-green region.

The writer, of course, agrees with Mr. Dow that if an eye cannot focus itself for a certain color no amount of light of that color will cause the observer to see distinctly; however, no difficulty of this sort was experienced by any of the observers.

In regard to Mr. Ashe's remarks in your issue of Oct. 28 the writer desires to say that there is no doubt that pupillary aperture affects acuity. However, the experiments of the writer referred to by Mr. Ashe were performed in a manner whereby pupillary aperture could in no way account for the greater acuity under monochromatic light.

Cleveland, Ohio. M. LUCKIESH.

Large Generators in Cincinnati.

To the Editor of Electrical World:

SIR:—I have read with much interest the able article on Cincinnati's Plum Street station in your issue of Nov. 4. The author, who is very well informed, refers to a large 3200-kw, 60-cycle, three-phase Bullock alternator in the following words:

"Among the varied large apparatus in the newer engine-room, principal historical interest surrounds the 3200-kw, 60-cycle, 4500-volt, three-phase Bullock alternator, driven by a 42-in. by 88-in. by 60-in. vertical cross-compound Allis-Chalmers engine at 75 r.p.m. This alternator, the only one of the so-called 'Berlin' type in America, is also declared to be the largest 60-cycle engine-driven machine ever built. It was completed under the design of Mr. B. A. Behrend, then chief engineer of the manufacturing company at Cincinnati. The rotating flywheel field element is 31 ft. in diameter and weighs complete with its coils 190 tons.

"Adjoining the large alternator set is a generally similar engine, driving the huge 2500-kw, 300-volt direct-current Bullock generator, itself a record breaker in the direct-current class and the largest 300-volt continuous-current

*See page 1252 of this issue.

generator ever built. The flywheel with which it is provided alone weighs 100 tons and runs at 75 r.p.m. The armature is 30 ft. in diameter and the commutator 16 ft. across.

It may be of historic interest for me to add that at the time these large units were installed they were not only the largest of their kind as far as size was concerned, but also the largest as to rated output. The type adopted is not exactly the "Berlin" type, as the able author of the article mentions, but a type peculiarly developed for the conditions which had to be met by the problem in question. The mounting of ninety-six pole pieces on a large steel flywheel required a peculiar construction of the supporting frame of the armature, and a frame was developed which was later patented and which consisted virtually of two large segmental cast-iron shields, almost 40 ft. in diameter, between which segmental punchings were mounted. A similar construction had been used by me previously for the 60-cycle flywheel-type generators installed in the municipal station of the city of Nashville, Tenn., where they have been in successful operation for many years.

The 300-volt, 2500-kw, direct-current generator was also one of the largest units ever built, though two similar gigantic units for 600 volts were later built under my supervision for the Boston Elevated Railway, where I suppose they will be the "last of the Mohicans" of this tribe, now fast vanishing from the field of heavy electrical engineering. We veterans of the profession enjoy the progress which leads to departures from the old types to which we gave life, form and existence.

B. A. Behrend.

Boston, Mass.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Homopolar Generator.—E. K. Scott.—An article illustrated by diagrams, in which the author points out that the homopolar generator has now a chance to succeed, as it is especially suited for driving by steam turbines. Curve A in Fig. 1 shows the speed of a line of homopolar generators that have been designed by R. H. Barbour, a sample

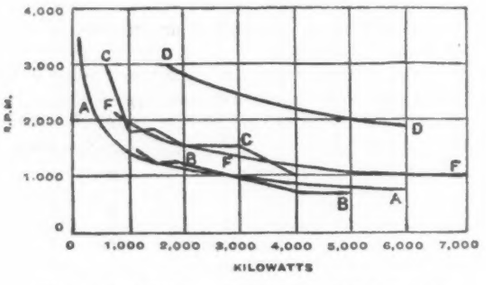


Fig. 1—Variation of Speed with Rated Output.

machine of which was exhibited at the recent Olympia electrical exposition in London. Curve B gives the lowest speeds of standard turbines by a certain maker. Curve C shows the speeds given by turbine builders as those at which they prefer the machines to run. Curve D represents the absolute limit of speed beyond which it would be mechanically impossible to run homopolar generators. Curve F shows speeds of homopolar generators having a peripheral velocity of about 16,000 ft. per minute, that is to say, about 25 per cent higher than Barbour's homopolar machine. As curves C and F almost always coincide, they prove that so far as speeds are concerned the steam turbine and homopolar machines are exactly suited to each other. Details are given of the Barbour homopolar generator, the construction of which has already been noted in the *Digest*. Considerable details are given about the brush construction, and comparisons are made with other special brushes. The brush consists of a flexible stranded copper core wound with an armoring of German-silver wire. This armoring has been found by experience to make better contact and give more consistent results as to friction, etc., than any other metal. Under actual test one of these brushes will collect 500 amp without any undue heating from a ring 14 in. in diameter and only ½ in. wide. With this brush the frictional loss is practically independent of the brush pressure and of the speed, but varies directly with the contact surface. Beyond a certain very moderate figure extra brush pressure has no effect on the contact volts. The current density found by experience to be suitable is about 100 amp per square inch, and the watts turned into heat per square inch of contact surface are 110 under these conditions. The watts per square inch in the case of ordinary slow-speed carbon brushes at the usual density of 40 amp per square inch are 116. The cost of manufacture of the homopolar machine is low. There is nothing in it except steel and a little copper and mica. There is no laminated structure. One interesting feature is the exceedingly easy way in which it can be compounded. All that is required is that the flexible connections from the brushes to the terminals shall be a little longer and be carried round in the same direction as the current that is flowing in the field coils. Then the current in the brush leads adds its ampere-turns, and by merely turning the brush leads the other way the compounding can be made differential.—Lond. *Elec. Review*, Oct. 27.

Single-Phase Commutator Motors.—F. Maguerre.—With reference to a former article by Gerstmeyer on the conditions of commutation of several types of single-phase commutator motors, the present author discusses the most important of these types with respect to starting performance and power-factor. The four systems under discussion are shown in Fig. 2. The chief results are as follows: At starting system *b* is superior to *c* in every respect. The power-factor in system *b* is also better near synchronism than in *c*, and the efficiency may also be somewhat better, but this difference ceases the higher the speed above synchronism, and it is shown that for *b* with increasing speed the power-factor reaches a maximum and then decreases. With respect to commutation it is possible neither with system *b* nor system *c* to overcome the reactance voltage,

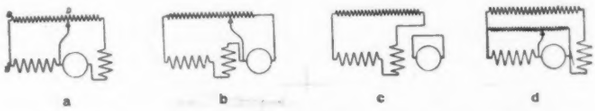


Fig. 2—Diagrams of Single-Phase Commutator Motors.

except by means of an interpole, but the easiest way of compensating the reactance voltage is provided by arrangement *d*. The article is illustrated by numerous vector diagrams.—*Elek. Kraftbetr. u. Bahnen*, Sept. 24.

Heyland Diagram.—H. J. S. Heather.—An article on the behavior of induction motors under the application of what is commonly called "reverse current," which in this connection really means polyphase currents so applied as to cause rotation of the resultant field produced by them in a sense opposite to that of the rotation of the rotor. An

induction motor used for lowering loads with a winding engine can be safely and satisfactorily braked at any speed by the application of such reverse currents. The author shows how all problems arising from this class of work can be very simply solved with the help of the well-known Heyland diagram.—Lond. *Electrician*, Oct. 27.

Lamps and Lighting.

Incandescent Lamp.—A note on a recent British patent (23,332, Oct. 19, 1911) of the "Z" Electric Lamp Manufacturing Company, Ltd., and F. Hoge, relating to a method of mounting that part of the central rod of a lamp to which the filament-supporting wires are attached. A glass bead is slipped over the central stem near the bottom, and in it the supporting wires are embedded. The leading-in wires are connected, by twisting and welding, one to each of two of the supporting wires. These are double, the other part being atached to the filament, so that the bead, which is loose, is held in position on the stem and the leading-in wires form a resilient support for it.—Lond. *Elec. Eng'ing*, Oct. 26.

Electric Furnace for Treatment of Metallic Filaments.—A note on a recent British patent (8996, Oct. 19, 1911) of G. Ludecke and the Imperial Lamp Works, relating to an apparatus for decarbonizing and sintering new metallic filaments. The inner well of a carbon cylinder or other refractory metal whose conductivity is lower than tungsten is coated with a deposit formed by evaporating the chlorides or oxy-chlorides of tungsten and molybdenum within the cylinder. In a preferred form the cylinder is evacuated and brought to incandencence and tungsten hexachloride is evaporated within, the high temperature causing a uniform and dense coating of tungsten to form on the interior. An inner cylinder of tungsten and an outer of carbon may be produced, the latter forming a part of the resistor. The cylinder is held between cast-iron rings, which are connected to conductor terminals.—Lond. *Elec. Eng'ing*, Oct. 26.

Oxides for Arc Lamps.—J. ESCARD.—An article illustrated by diagrams on arc-lamp electrodes made from metallic oxides. The author first gives the characteristic features of an arc formed between oxide electrodes, and especially of the magnetite arc, and then deals with the composition of the electrodes and gives some details of the manufacture of the electrodes for the magnetite arc lamps.—*La Revue Elec.*, Oct. 27.

Nernst Lamp.—R. A. HOUSTOUN.—In a continuation of his long illustrated serial on studies in light production the author deals with the Nernst lamp, giving figures of temperature and energy distribution curves.—Lond. *Electrician*, Oct. 27.

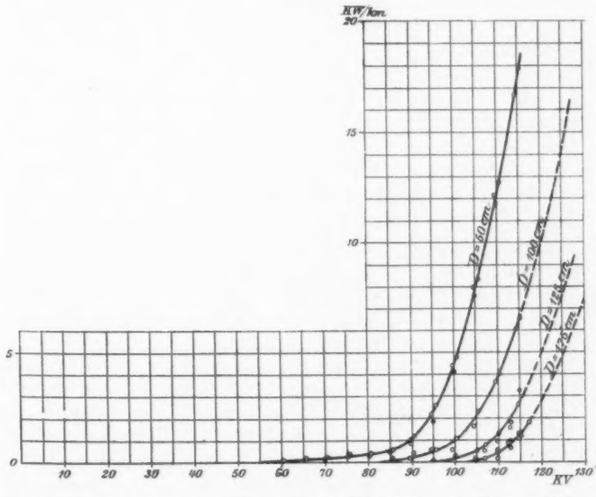


Fig. 3—Corona Loss in a Three-Phase High-Tension Transmission Line.

Generation, Transmission and Distribution.

Corona Losses in Overhead Wires.—H. GÖRGES, P. WEIDIG AND A. JAENSCH.—The authors have made laboratory tests to determine the corona losses in high-tension wires with special reference to the 100,000-volt Lauchhammer transmission plant. The tests were made with the size of conductors used in this transmission line, the conductor consisting of seven wires each of 6 sq. mm (0.009 sq. in.) cross-section. Hence the total cross-section of the conductor is 42 sq. mm (0,065 sq. in.). Two such conductors were stretched horizontally about 4.5 m (15 ft.) above the ground. The curve of the voltage applied was nearly sinusoidal. The frequency was 50 cycles per second. The losses were determined for four distances on the conductors from each other, namely 50 cm, 100 cm, 125 cm and 175 cm (or 1.64 ft., 3.28 ft., 4.1 ft. and 5.74 ft.) for voltages up to 115,000, and the losses were calculated for 1 km (0.62 mile) length, an atmospheric pressure of 750 mm mercury and a temperature of 17 deg. C. The results are given in Fig. 3. The four curves refer to the four distances between the conductors as indicated. The dotted parts of the curves are extrapolated. Since the results for the greatest distance of 175 cm (5.74 ft.), which is that of the Lauchhammer transmission plant, are somewhat uncertain, a checking calculation was made. If it is assumed that the corona losses occur essentially in close proximity to the wires, it may be concluded that these will be approximately

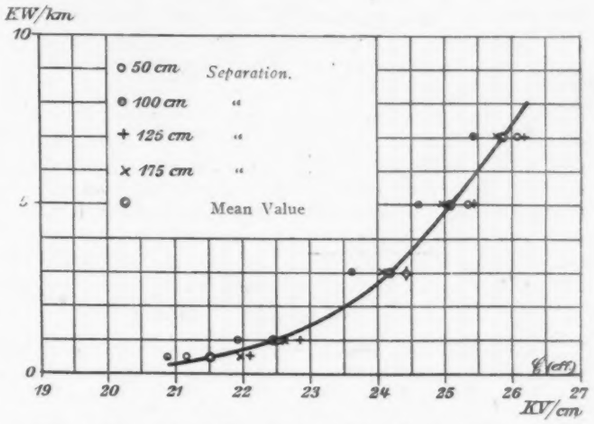


Fig. 4—Corona Loss Expressed in Kilovolts per Centimeter.

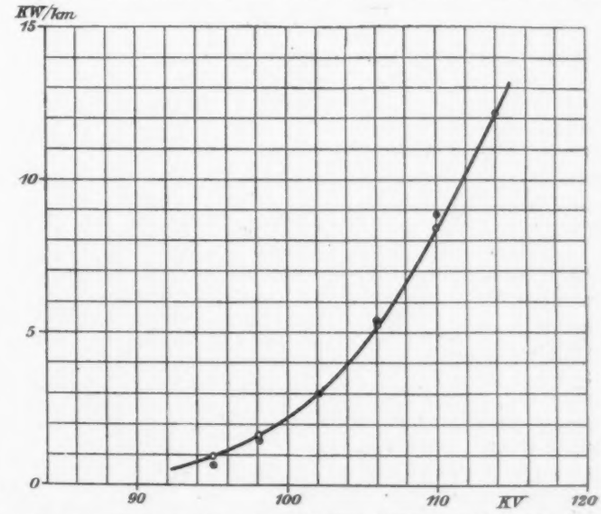


Fig. 5—Corona Loss in a Three-Phase System as Obtained from Calculation.

the same for different distances between the wires if only the electric field intensity (in volts per centimeter) at the surface of the wires is the same. To test this, the effective volts P were taken from Fig. 3 for different values of kilowatts per kilometer. Then the electric field intensity in effective volts per centimeter at the surface of the wires was calculated from the volts P from the formula $P \div [2\,r \log. (D/r)]$, where r is the radius of the conductor and D the distance between the conductors. As a result of this calculation the losses in kilowatts per kilometer are given as a function of the kilovolts per centimeter in Fig. 4 and are shown to be approximately independent of the distance between the conductors, thus confirming the above conclusion. Finally the results are used to calculate the corona losses for a three-phase system, if each conductor consists, as before, of seven 6-sq. mm wires and the distance between the conductors is again 175 cm. The results were calculated by two different methods, which gave practically the same results, as shown in Fig. 5, where the abscissas represent effective kilovolts.—*Elek. Zeit.*, Oct. 26.

Traction.

Single-Phase Locomotive.—J. Perrot and R. van Cauwenberghe.—An illustrated detailed description of the new single-phase locomotive built for the French Southern Railway. There are three 500-hp motors. For voltage regulation induction regulators are employed. The three 500-hp main motors are compensated series machines. Besides the excitation winding the stator has two parallel-connected compensation windings which also serve as commutation windings. The normal speed is about three times synchronism. Near synchronism the motor is connected as a repulsion motor. Since the French Southern Railway required electric braking so as to recuperate energy, the two compensated repulsion motors which drive the Westinghouse air compressor and the ventilators are provided with a special winding which is displaced by 90 space degrees against the main winding. When running down hill the main motors are excited as shunt generators from this winding so that an emf in time-quadrature with the excitation voltage and therefore almost exactly in time-phase with the network voltage is produced.—*Elek. Kraftbetr. u. Bahnen*, Sept. 24.

London Tramway System.—A long abstract of last year's financial report of the municipal London tramway system. The result of the year's working of the whole system is that the electrical system shows a surplus of $4,572,090 and the horse system a loss of $96,850. The electric cars ran 45,744,066 miles and the horse cars 2,357,504 miles, the number of passengers carried being 482,296,935 and 22,418,391 respectively. The traffic receipts from electric cars show a decrease of 0.42 cent per car-mile as against the previous year, while the receipts per car-mile from the horse lines show an increase of 0.12 cent. The fall in the receipts from the electric cars is due to the fact that the recently opened lines are unremunerative, and it will be a considerable time before these are fully developed. A diagram is given showing variations of the number of passengers carried throughout the year. The operating costs for electric traction were 12.72 cents per car-mile as against 12.70 cents last year. A sum, however, has to be added on account of special charges, making the total 12.96 cents per car-mile, compared with 12.84 cents a year ago. This increase is the result of fluctuations under every head. The total energy cost per kw-hour generated, including interest and sinking fund, is 0.7 cent. The total number of kw-hours used during the year was 111,527,301. The total capital investment for the whole tramway system is as follows:

Total electric traction	$47,478,700
Horse and cable traction	1,861,000
Obsolete capital (horse traction)	8,754,500
	$58,094,200

If to the cost of energy generation given above the cost of distribution is added, with the corresponding capital charges, the total is 1.24 cents per kw-hour, no allowance being made for depreciation.—Lond. *Electrician*, Oct. 27.

Hamburg Suburban Road.—Freund.—Since the suburban road from Blankenese to Oldsdorf has introduced electric traction (the single-phase system being used), the traffic has enormously increased. This is due to the much greater number of trains during the day. While at the end of 1907 there were only 122 trains a day, the trains now follow each other every five minutes. The increased traffic has necessitated the building of twenty-five new motor-cars, which are at present being used for lengthening the trains. But in future the trains are to follow each other at intervals of two and one-half minutes. The construction of these motor cars is described and illustrated in great detail. The article is to be concluded.—*Elek. Zeit.*, Oct. 26.

Wires, Wiring and Conduits.

Fuses.—An illustrated description of several fuses exhibited at the recent Olympia Electrical Exhibition in London. The first is a bi-metallic fuse. It consists of a copper wire covered with a thick layer of tin alloy. The latter melts off before the fuse blows, so that there is no spluttering of tin, and, while not liable to oxidization and aging,

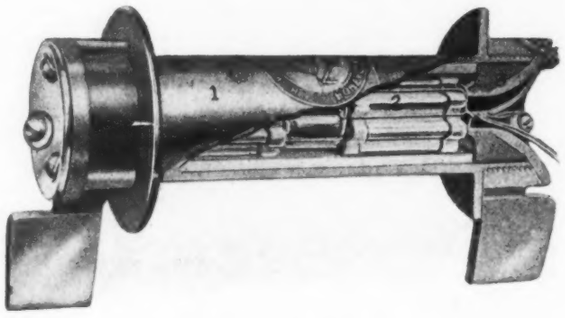


Fig. 6—The "Honey-Comb" Fuse.

the fuse blows as cleanly as ordinary copper fuses. In addition, the construction enables it to carry even 90 per cent of its fusing current almost indefinitely, and it will stand momentary overloads without blowing. Another fuse exhibited was the "honeycomb" fuse, designed to withstand heavy short-circuits. Fig. 6 shows the construction. The outer body consists of a red fiber tube, 1, lined with a fire-resisting compound. The ends of the fiber are screwed to receive contact ends, and the end caps or baffle plates, 3, are of gun-metal lined with hard fiber. Inside is a cylindrical china body, on the outer surface of which are a number of cells, 2, in which the fuse wires are placed, while through the center of this body there is a hole with a tapered opening at either end. This central chamber serves as an expansion chamber. Round the center portion of the outer surface of the honeycomb cylinder is fixed a tin "time-element band," which is connected to the terminals by copper strands. In addition a number of small copper strands, varying in number from three to six, according to the size of the fuse, run right through from terminal to terminal. The action of the fuse is as follows: Running on a small load, the copper "through strands" carry the bulk of the current, as their resistance is lower than that of the tin band, but as the load increases the temperature of the copper "through strands" rises, and the resistance of these strands becomes greater until a portion of the current is shunted and carried by the central tin band. When the load exceeds the maximum continuous rating of the fuse the temperature rises until the latter is melted. All the load is then thrown on the copper "through strands," which immediately fuse. It will be seen, therefore, that on ordinary overload conditions the break takes place on the copper

through strands only, and consequently a comparatively small mass of metal only is volatilized. On a heavy short-circuit, however, the "fusible tin band" is as a rule left unfused, the connecting copper strands fusing instead.—Lond. *Elec. Eng'ing.*, Oct. 26.

Electrophysics and Magnetism.

Transverse Thermomagnetic Effect in Nickel and Cobalt.—A. W. SMITH.—An account of an experimental investigation of the transverse thermomagnetic effect, or Nernst effect, in nickel and cobalt. The author investigated especially the variation with the temperature of the plate and its relation to the Hall effect and to the magnetic properties. The chief results are as follows: The relation between the Nernst emf and the magnetic field was examined in nickel at a number of temperatures between 56 deg. C. and 310 deg. C. For a given magnetic field it was found to increase with rising temperature until the critical temperature was reached. The rate of increase becomes greater the nearer the critical temperature is approached. In passing the critical temperature the Nernst effect decreases to a small fraction of its value at that temperature and then probably decreases with further rise of temperature. For any particular temperature below the critical temperature the Nernst emf is at first proportional to the magnetic field, but when the intensity of magnetization approaches its maximum there is a rapid deviation from this proportionality and the emf approaches a limiting value at higher magnetic fields. Since the maximum intensity of magnetization decreases with rising temperature, the fields necessary to produce saturation become less as the temperature is increased. At temperatures above the critical value the Nernst emf is proportional to the magnetic field. The study of the Nernst effect in cobalt between 56 deg. and 550 deg. showed that the Nernst emf is proportional to the magnetic field over that interval of temperature and over the range of magnetic fields in these experiments. In nickel the Nernst effect increases more rapidly than the Hall effect with rising temperature and in cobalt it increases less rapidly than the Hall effect. In this respect cobalt behaves like iron.—*Phys. Review*, October.

Units, Measurements and Instruments.

Electric Clocks.—An illustrated description of electric clocks exhibited at the recent Olympia Electrical Exhibition in London. An "earth-driven" clock is described, the current being obtained from a carbon plate and a zinc plate buried in the ground. A new astronomical clock is then described in which an impulse is given to the pendulum and a contact made every second. Several improvements over former arrangements are claimed. The pendulum releases the impulse lever while it is passing through the central one-tenth degree of its swing. Variations in the friction of the release do not, therefore, affect the time of vibration of the pendulum apart from producing an alteration in the arc. The impulse is delivered during the first one-quarter degree of swing after passing the center. This delaying of the impulse introduces an escapement error which decreases with increasing arc and thus compensates the increase in the circular error produced by increasing arc. The inevitable variations of arc due to change of density of the atmosphere and variations of friction are reduced to a minimum, since the impulse lever and pallet are so designed that an increase of arc automatically causes a decrease of impulse. During the whole of the time that the lever is giving impulses to the pendulum it is absolutely free, since the pallet leaves it before it comes into contact with the remontoire. The escapement mechanism being symmetrical, without duplication, an impulse is given and a contact made each half swing, that is, once per second, since a seconds pendulum is used. The contacts are of brief duration and perfectly clean, and owing to the introduction of a spring beneath one of the contact plates the kinetic energy of the impulse lever is stored instead of being wasted. This materially reduces the energy required to reset it. The self-induction and resistance of the circuit are so adjusted that under normal conditions a decrease in the current produces an increase in the throw of the remontoire. The movement is shown in Fig. 7. The impulse pallet is in the form of a small wheel *A*,

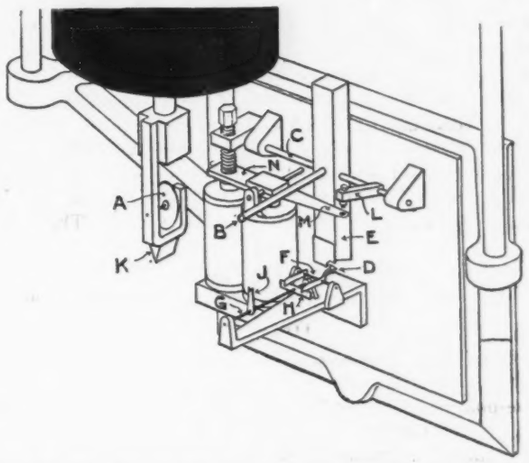


Fig. 7—Movement of the "Synchronome" Astronomical Clock.

mounted centrally on the lower end of the pendulum, and the impulse lever is in the form of a round steel rod *B*, pivoted at one end about the horizontal axis *C*, and placed so that the free end is immediately over and almost in contact with the top of the pallet wheel *A* when the pendulum is at rest. The lever is normally held in this position by the catch *D*, which engages with the end of the loading bar *E*, mounted vertically on the axis of the lever. This catch is pivoted about the axis *F*, parallel to the axis of the lever. The latter is released by means of the trip axle *G*, which carries at one end the small cross-bar *H* engaging with the tails of the catch *D* in such a way that a small rotation of the axle in either direction lifts them and depresses the point of the catch. The requisite slight rotation is brought about each time the pendulum passes through its central position by means of the trip tail *J*, which is just hit by the agate knife edge *K*, attached to the bottom of the pendulum below the pallet wheel. The impulse lever being released when the pendulum is in its central position comes into contact with the pallet wheel then immediately below it, and as the pendulum continues its swing the lever runs down the edge of the wheel, communicating energy to the pendulum. The downward acceleration of the lever increases with the increasing slope of the plane of contact with the pallet until it becomes equal to the acceleration the lever would have were its motion unrestrained by the pallet. Since the acceleration of the lever cannot increase beyond its amount, the lever and pallet wheel then part company and the impulse of the pendulum terminates. The lever is allowed to travel some little distance further before the contact arm *L* comes into contact with the contact spring *M* attached to the armature *N* of the resetting electromagnet. The impulse lever is, therefore, absolutely free while giving impulse. If the arc of vibration increases slightly, the lever and pallet wheel part company sooner; that is, before the lever has traveled the normal amount. Consequently the impulse is reduced in value. Similarly a slight reduction in the arc enables the lever to remain in contact with the pallet for more than the normal distance, with a consequent increase in the value of the impulse. The impulse, therefore, exerts a governing effect on the arc of vibration. Any number of subsidiary dials indicating time second by second may be operated by this master clock, and the circuit may also

include chronographs or other seconds-indicating devices. —Lond. *Electrician*, Oct. 27.

Measurement of Gases.—C. C. Thomas.—A long illustrated Franklin Institute paper on the different formulas for calculating the flow of gases through pipes and on commercial meters for measuring this flow. The Pitot, Venturi and electric meters all give accurate and reliable results when properly used under favorable conditions and when observations are taken with a sufficient degree of refinement and method. The electric meter gives continuous results, either graphical or integrated, even under severe commercial conditions of operation, that compare most favorably with the best that can be obtained with other forms of direct-reading meters or by frequent observations on Pitot tubes and the use of tables and coefficients derived from the most thorough calibrations; and it gives these results directly in any standard units desired, regardless of the pressure and temperature of the gas flowing through the meter.—*Jour. Franklin Inst.*, November.

Telegraphy, Telephony and Signals.

San Francisco.—S. G. McMeen.—A fully illustrated description of various features of the telephone system serving San Francisco and suburbs. The system consists of a wire plant of submarine, underground and aerial cables joined to ten groups of automatic switching apparatus housed in ten buildings. Five of the buildings are in San Francisco, four are in Oakland and one is in Berkeley. The author deals especially with some features of the work in San Francisco.—*Journal Western Soc. of Engrs.*, October.

Damping of Short Electric Waves.—M. Levitsky.—The author describes a new form of closed resonator for measuring the damping of short waves, which is particularly difficult in the case of open transmitters. The difficulty is mainly due to the rapidly increasing disturbance by neighboring conductors, and it is impossible to separate the decrement of the secondary from that of the primary. The difficulty may be overcome by choosing a receiver whose oscillations are practically undamped and sufficiently intense to give a well-marked resonance curve. An account is given of experiments showing that the resonator which he used was practically undamped, the decrements being those connected with the oscillator only.—Lond. *Electrician*, Oct. 27.

New Apparatus and Appliances

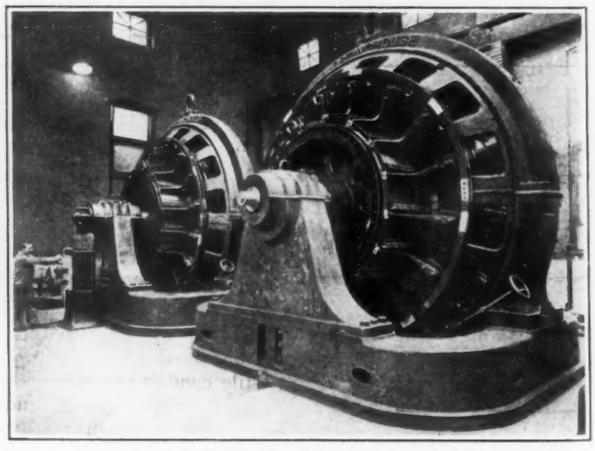
ELECTRIC COOKING ABOARD A LIMITED TRAIN.

The fast limited trains of the Burlington route between Chicago and the Northwest are lighted by electricity furnished by a 110-volt head-end turbine generator. In the competition between several lines to make their own accommodations most attractive to travelers Mr. A. E. White, commissary for the road, has just installed cooking devices in the lounging and buffet cars of the principal trains on which all cooking is done electrically. Each car is equipped with a General Electric percolator, toaster, chafing dish, egg boiler, small frying-pan, tea-kettle and water heater. Each table is arranged with six outlets, from which as many appliances can be operated. For evening "snacks" the various appliances are brought directly to the table and the cooking is done under the eye of the guest. Ladies who prefer to manipulate the utensils and thus give evidence of their culinary skill are encouraged to supervise their own orders if they so wish. The morning breakfasts are prepared on the electrical appliances in the buffet kitchen, several orders of toast, eggs, etc., being prepared in advance and kept warm in the devices run at low heat. The percolator, however, is used directly on the table. The low voltages generally used in train-lighting systems have prevented the general adoption of electric cooking, but the 110-volt head-end system used on the Burlington permits the use of standard apparatus.

Electric Cooking in Buffet Car.

CONVERTERS OF MAXIMUM OUTPUT.

In the accompanying illustration are shown two rotary converters in a substation of the Brooklyn Rapid Transit Company, which are rated at 3000 kw each and are 25-cycle, six-phase, 600-volt machines. Two units of this same type, built by the Westinghouse Electric & Manufacturing Company for the Interborough Rapid Transit Company, New York, a little over a year ago, replaced two 1500-kw converters which occupied the same floor area. This company subsequently obtained seven more converters of the same type. These converters are said to afford the maximum output thus far obtainable within the floor area involved, and in fact to represent the largest output rating ever obtained from a converter.

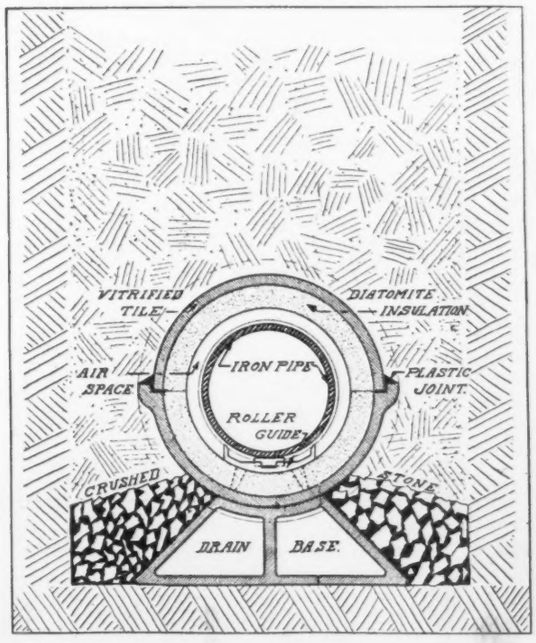


Rotary Converters of Maximum Output.

IMPROVED UNDERGROUND STEAM-HEATING LINE CONSTRUCTION.

A novel and patented adaptation of vitrified-tile conduit has been applied by Evans, Elmirall & Company, of New York and Chicago, to the improved construction of underground steam-heating mains and lines. The pipe itself, properly insulated, is carried within a split vitrified-tile conduit, which in turn rests on the hollow drain-base shown in the accompanying section. Both drain-base and conduit are made in sections of the same length, but are installed in break-joint arrangement, a recess in the center of each base section forming a lock for the bell of the conduit. This interlocked construction makes impossible a change in levels or separation of the joints. The flat bottom of the drain-base also gives the desirable firm foundation required for good underground work. Drainage water is free to enter the tile base at the joints, which are left open and are protected against the entrance of earthy matter by the crushed stone or gravel placed alongside, as shown in the illustration, this latter acting as a filter material.

The diatomite or kieselguhr insulation used inside the tile conduit consists of the fossil silica skeletons of minute diatoms, of which there are millions to a cubic inch, interspersed with numberless air cavities. These air cells give diatomite its heat-insulating qualities, while the material of the minute bodies is both insoluble in water and indestructible by acids. The wrought-iron pipe is supported on roller bearings, making it free to move between expansion joints. The weight of the bearing is borne by legs extending through the diatomite and resting on the tile.



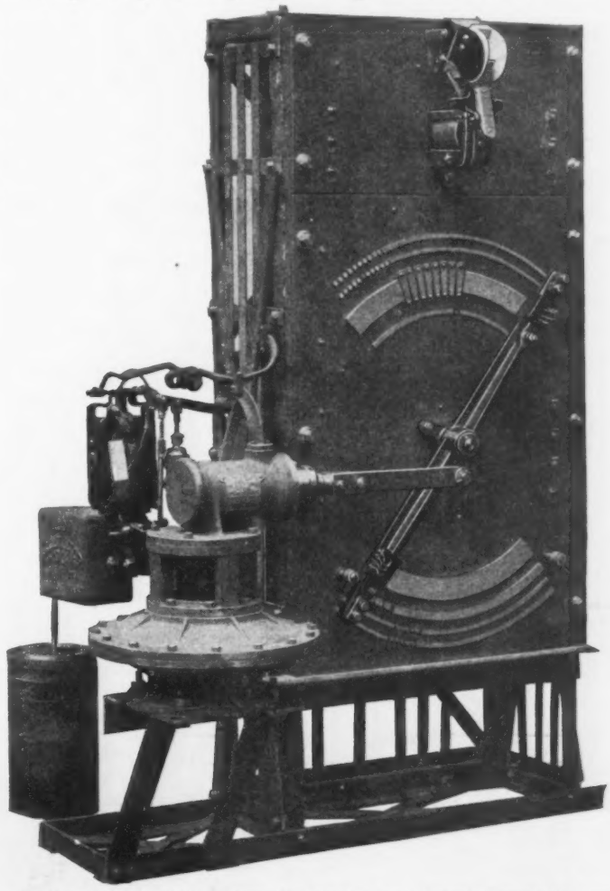
Cross-Section of Trench, Showing Underground Steam-Heating Line Construction.

In the process of making the tile conduit the longitudinal cuts on the sides, which divide it into an upper and a lower section, are not made entirely through the wall, enough material being left to keep the two halves intact for splitting on the job. Here they can be easily separated with the aid of a hammer and chisel. The lip running along the lower section of the longitudinal joint forms a groove for supporting the cement used to make a tight joint. The tile itself is made from a combination of stoneware clay, spar and fireclay, thoroughly ground and mixed, and is free from iron, lime or other injurious substances. All sections are salt-glazed inside and out, making the tile waterproof.

AUTOMATIC STARTER AND SPEED REGULATOR FOR TWO MOTORS.

The Cutler-Hammer Manufacturing Company, of Milwaukee, is placing on the market a new pressure-controlled motor speed regulator, illustrated herewith, for use with two motors. This apparatus starts or stops either of two motors and varies their speeds as service demands. On boiler draft systems, where they are used to the greatest extent, they vary the mechanical draft and thereby maintain pressure in the boilers between fixed limits.

The controller shown was installed in connection with two motors of 3½ hp and 5 hp capacity, respectively, each driving a triplex oil pump feeding oil-fired boilers. The oil is fed to the boilers under a pressure of about 35 lb. per square inch. The oil fed varies with the demand on the boilers. In this particular case the small pump takes care of ordinary operating conditions, and both are used only when heavy load conditions prevail.



Pressure-Controlled Automatic Starter and Speed Regulator for Two Motors.

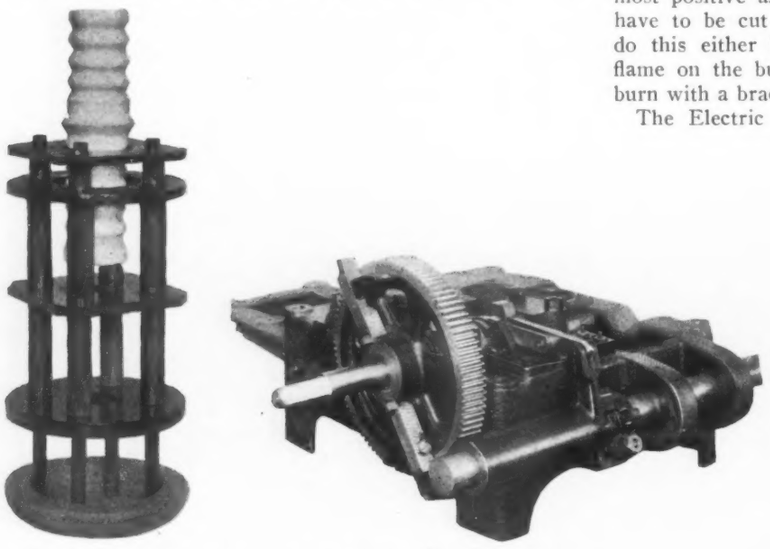
The small motor is started automatically and accelerated to normal speed and above this if necessary. If this does not supply the oil needed a clapper switch, shown at the top, closes the circuit to the large motor and this is brought up to the speed and varies it as required. When the demand on the boiler decreases so that the smaller motor can again do the work the larger one is cut out of the circuit. This controller, therefore, eliminates the need for an attendant and reduces power consumption to a minimum, accomplishing this result precisely and better than is possible by manual operation.

DEVELOPMENTS IN OIL-SWITCH DESIGN.

The introduction of the high-speed steam turbine for operating large generating units has brought about a demand for switching apparatus of high rupturing capacity, and, because experience has shown that the motor-operated type "H" switch is capable of rupturing large amounts of power, two new switches of similar design, but with greater rupturing capacity, have been developed by the General Electric Company. They will be known as the "H-6" and "H-7," and are identical except for a few details necessary to adapt them to different styles of cell construction. Both switches are designed for mounting the different phases in separate cells, but the "H-7" oil switch is so arranged that further separation is secured by the addition of barriers placed between the breaks of each phase.

The secondary contacts of the switches are, with slight modification, similar to those used in the previous types. For current capacities above 300 amp, however, additional contacts, known as primary contacts, are provided. These are shown in Fig. 1, and serve to carry almost the entire current while the switch is closed. In opening the switch they break contact before the cylindrical rod which opens the circuit and ruptures the consequent arc in oil. The movable primary contacts consist of double sets of contact fingers, made of drop-forged copper, fastened to a movable cross-head by flat springs fitted with copper laminations and reinforcing springs. The stationary primary contacts are wedge-shaped copper blades fastened to the top of the oil vessel. The diameter of the oil vessels has been increased from 8 in. to 10 in., giving a larger volume in the oil vessel. The larger oil vessels have also been made stronger by increasing the thickness of the steel walls.

By means of baffle plates the movement imparted to the oil by the expansion of the gases formed by the arc when the circuit is opened is checked and diverted in such a manner as to allow the gases to separate from the oil and escape, while the oil itself drops back into the oil vessel. Fig. 2 is an illustration of the baffle. The movement of the oil is away from and toward the center of the oil vessel on breaking the circuit, and the oil loses its velocity before it reaches the cover, thus reducing its tendency to be thrown out.



Figs. 1 and 2—Details of Oil-Switch Design.

As in the other types, the switch is opened and closed by compression springs. The operating motor does not actually throw the switch, but serves merely to compress the springs. The weight of the movable parts of the switch is counterbalanced, so that when the switch operates the force of the compression springs closes the contacts by throwing the lever to approximately 1½ in. from the opposite position, after which the motor compresses the springs for the remainder of the distance. The switch closes and opens with equal ease. The operating springs are held in compression by the main operating toggle of the switch and by a dog bearing against a roller stop, which, when released, allows the switch to operate. The main operating toggle is slightly over center when the switch is at rest; thus the pressure of the dog against the roller stop is merely sufficient to overcome the tendency of the main toggle to buckle. The means of holding and releasing the dog insures positive operation of the switch. When the switch is operated it either closes or opens, as the case may be, in one single stroke and remains in that position.

The locking mechanism is an important improvement in the switch, and one which removes the chance of trouble which might occur with the old switches if the toggles were not properly set. Although primarily developed for the switches described, this feature will henceforward be embodied in the design of all switches of the "H" type. The switches are built in current-carrying capacities up to 4000 amp for voltages up to 15,000. They are also made for voltages up to 70,000, and will operate satisfactorily, it is claimed, on systems the combined load of which connected to the bus is not greater than 50,000 kw. They are made in two forms, one in which the poles are made in parallel sets of two, as in previous designs, and the other in which the poles are arranged in tandem.

VEHICLE STORAGE-BATTERY CELL DISCONNECTOR.

The individual cells in the various types of "Exide" batteries are joined together by connectors integrally burned to the strap post, which burned connection is the most positive and satisfactory. When one or more cells have to be cut out it has heretofore been customary to do this either by loosening the connector by putting a flame on the burn, over the post, or boring through the burn with a brace and bit.

The Electric Storage Battery Company has now perfected a connector puller, a device which mechanically uncouples the connectors by shearing, leaving both post and connector in perfect condition for reburning. In order to accomplish this it is necessary that the plunger which does the shearing be very accurately aligned and centered.

Storage-Battery Disconnector.

The connector puller fits the pillar strap of all types of "Exide" cells, including the "Ironclad-Exide," and is manufactured in two sizes. One size fits all cells corresponding to the thirteen-plate "Exide" (5-in. jar) and smaller; while the other fits those corresponding to the fifteen-plate "Exide" (5¾-in. jar) and larger.

Industrial and Commercial News

THE WEEK IN TRADE.

EXPANSION has taken place this week in the volume of business transacted throughout the country, and with this improvement in the turnover there has also been a decided growth in confidence for further improvement. Just how long this optimism will last cannot be predicted with any degree of certainty in view of the irregular trend of business in the past few months, but conditions seem unusually favorable at this time for a period of advancement in general trade. Stocks of various commodities are low, prices in general are attractive, and the various factors that have brought uncertainty and hesitation into business matters during the year are either being eliminated or are losing their force. While the plan for reorganization of the American Tobacco Company approved last week by the United States Circuit Court does not give entire satisfaction to independent tobacco interests or furnish a complete guide for reorganization of every corporation that may be charged with violation of the Sherman anti-trust law, the fact that a solution of the matter was found, and the welfare of the company protected, helps to dispel much of the apprehension attendant upon the federal suits. Knowledge that the year's crops are abundant is another favorable influence upon the trade situation, for completion of harvesting will mean more purchasing in various sections and consequent expansion in a number of important industries. Low prices in the steel markets are bringing out substantial contracts for rails, cars, bridge equipment and other steel products, and activity at the mills is assured for some time to come. Indications that stocks of pig-iron held by large consumers will need replenishing are exceedingly good. Railroad earnings are becoming better and tonnage reports show that shipments of various commodities are increasing rapidly. Prices in the cotton markets are still too uncertain to induce buyers to commit themselves very far in the future. Business failures for the week ended Nov. 9, as reported by *Bradstreet's*, were 237, as compared with 200 last week, 207 in the corresponding week in 1910, 221 in 1909, 267 in 1908 and 259 in 1907.

THE COPPER MARKET.

ATTEMPTS to advance copper prices in view of the apparently favorable statistics in the October report of the Copper Producers' Association have been moderately successful, and domestic consumers entering the market have given 12.5 cents to 12.6 cents cash for electrolytic for November, 12½ cents to 12⅝ cents for December and January and between 12⅝ cents and 12¾ cents for later delivery. Foreign buying has expanded slightly, and consumers abroad have paid advances of 5s. to 10s. for eltctroolytic. Consumers still believe in spite of the October statistics that the present rate of production and the present outlook in general trade justify continuation of the hand-to-mouth policy. Judging from the condition of the market in the past few months, either the buying movement will have to become greatly broadened and make substantial inroads upon surplus stocks or the rate of production will have to be greatly lowered before the consumer need be concerned with sharp advances in price. The fractional advances that have just taken place savor of the professional and have had but very little influence in increasing the volume of sales. Standard copper in New York has revived slightly, following the lead of the London market, in which activity was quite marked after the October report was made public. Export business at present is at a rate slightly larger than that of October, and exports including Nov. 14 aggregate 12,131 tons. The daily call on the Metal Exchange, Nov. 14, quoted copper as per the accompanying table.

Standard Copper	Bid.	Asked.	Settling Price.
Spot	12.20	12.35	.....
November	12.20	12.35	12.27½
December	12.25	12.40	12.32½
January	12.25	12.40	12.32½
February	12.30	12.45	12.37½

The London market, Nov. 14, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	56 15 0	56 16 3
Standard copper, futures	57 8 9	57 10 0

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.35c	11.57½c
London, spot	£57 10 0	£53 7 6
London, futures	58 2 6	54 0 0
Best selected	61 10 0	57 3 0

INDUSTRIAL AND COMMERCIAL NOTES.

General Electric Sales.—Recent orders received by the General Electric Company, Schenectady, N. Y., include the following: From the Haskell & Barker Car Company, which is remodeling its entire electrical equipment and changing from alternating-current to direct-current motor drive at its large car-manufacturing plant at Michigan City, Ind., for one motor-generator set, ninety-seven induction motors and a switchboard; from the Ingersoll-Rand Company, New York City, for four synchronous motors aggregating 1400 hp, four exciters, four synchronous panels and one black panel; from the Carnegie Steel Company, Pittsburgh, Pa., for one synchronous motor-generator set and a switchboard, for use at the Schoen Steel Works, McKee's Rocks, Pa.; from the Itaska Paper Company, Grand Rapids, Mich., which manufactures news paper and is equipping its mill electrically, for eight induction motors aggregating 725 hp; from the American Hide & Leather Company, Ballston Spa, N. Y., for five induction motors aggregating 150 hp, replacing steam-engine drive; from the Mark Manufacturing Company, Chicago, Ill., manufacturer of conduit, for three centrifugal air compressors, which will furnish air blast for oil-firing the ovens used in baking the conduit; from the Robert N. Basset Company, Shelton, Conn., which is installing individual motor drive, for three three-phase generators, one transformer, forty-eight induction motors, thirty-one direct-current motors and a switchboard; from the Bush Terminal Company, New York City, for four battery truck cranes for service at its terminal at Brooklyn, N. Y. The General Electric Company has recently sold mining locomotives as follows: One locomotive to Asker Coal Mining Company, for Dorothy, Ky.; one to Ben Franklin Coal Company, for Braeburn, Pa.; one to Inland Steel Company, for Crosby, Minn., and one gathering locomotive to Davis Colliery Company for Elkins Colliery Company, Bower, W. Va.

Meeting of the Jobbers' Association.—The Electrical Jobbers' Association held its quarterly meeting at the new Homestead Hotel, Hot Springs, Va., on Nov. 8, 9 and 10. The main theme discussed at the business meeting was efficiency methods to reduce the cost of conducting the business of jobbers and dealers in electrical supplies. The attendance of both jobbers and manufacturers was large, and the social features of the occasion absorbed even more attention than the business of the organization. There were tournaments in golf, tennis, billiards and pool, with cups and other trophies to make the several events interesting and zestful. The next meeting of the association will be held at St. Augustine, Fla., in February, 1912.

More Equipment Ordered for Appalachian Power Company.—Messrs. Viele, Blackwell & Buck, engineers for the Appalachian Power Company, of Richmond, Va., which is building hydroelectric stations and distribution systems in Virginia and West Virginia, as described in these columns Oct. 7, have awarded the contract for the transmission-line fittings to the Harrison Electric Manufacturing Company, of Brooklyn, N. Y.

Large Lamp Consumers.—At the recent Chicago convention of the Association of Railway Electrical Engineers the interesting statement was made in conversation that the Pennsylvania Railroad is the second largest consumer of incandescent electric lamps in the United States. The largest consumer is said to be the group composed of the associated Edison companies.

Western Electric Business Shows a Slight Decrease in October.—During the month of October shipments of the Western Electric Company showed a decrease of 5 per cent as compared with those in October, 1910. During September, as previously stated in these columns, the shipments of the company were 12 per cent larger than those in September of the previous year, and the difference between this gain and the decrease for October noted above is explained by the fact that the September increase was due in part to including with the September record shipments on orders placed earlier in the year. As the monthly records are compiled on a shipment and not on an order basis, the 5 per cent decrease in October does not indicate an equivalent decrease in sales. Sales of the company for ten months of 1911 represent an increase of about 3 per cent over those in the corresponding period last year. The gain has not been uniform throughout the various territories, and in a large measure improvement has been more marked in foreign than in domestic business. In this country in October all sections excepting the Pacific Coast showed decreases, and the greatest falling off was in the East. Considerable improvement has been shown thus far in the year in sales of motors, generators and lamps, and the telephone branch of the business has also shown expansion. The actual number of orders received in ten months of the present year is larger by some 7 per cent than those in the corresponding ten months last year, and this difference indicates a small decrease in the average size of order. From present indications the year's business will approach $66,000,000, in which case 1911 business will be exceeded only by that of 1906, which represented a total of $69,000,000.

American Blower Company Forms Canadian Sirocco Company, Ltd.—Application for a charter has been filed by the Canadian Sirocco Company, Ltd., of Windsor, Ont., the function of the company being the manufacture and distribution of the American Blower Company products in the Dominion of Canada. The full line of American Blower Company fans, blowers, heating, ventilating and drying apparatus, steam engines, etc., will be manufactured. The company will hold the exclusive patent rights to manufacture Sirocco fans and blowers throughout Canada. These patents are controlled in the United States, the United States' possessions, Mexico, Central and South America and in Japan by the American Blower Company, of Detroit, Mich., and in Europe by Davidson & Company's Sirocco Engineering Works, Belfast, Ireland, the home of S. C. Davidson, inventor of the apparatus. The Canadian Sirocco Company, Ltd., has acquired a tract of land comprising four and one-half acres on the Essex Terminal Railway from the city of Windsor, and it will proceed at once to erect upon this site a plant which, it is said, will be the finest and most comprehensive of its kind in the country. An erecting shop 50 ft. by 200 ft., of steel and concrete construction, is to be started at once, and this with the office buildings will be completed for occupancy this winter. A foundry building will be started in the spring and work upon the plate and pipe shop, machine shop and the remainder of the plant will be advanced as rapidly as possible.

Postal Telegraph Company.—The current issue of the *Postal Telegraph*, the monthly bulletin of the Postal Telegraph Company, contains an article assailing the Western Union Telegraph Company for combination with the American Telephone & Telegraph Company, alleging that this combination is in violation of the Sherman anti-trust law. Reference is made in the article to various statements of Theodore N. Vail, president of the Western Union Telegraph Company, that were to the effect that the close relation between the two companies is in the nature of a public benefit, and in attacking these statements the article says in part: "Mr. Vail says the purchase by the American Telephone & Telegraph Company of the stock of the Western Telephone & Telegraph Company is similar to the purchase some time ago of the Mackay Companies' holdings of telephone stock. The fact is that the Mackay Companies sold their telephone stock to avoid even the appearance of combination. This sale of Western Telephone stock is to complete a combination." The Western Union's statement to the effect that 80 per cent of the Postal's net profits were obtained from its cable operations is denied strongly, and the vast land lines of the company are pointed to in support of the denial. The bulletin contains further reference to the matter of the combination, saying that now that the Bell Telephone and Western Union have practically eliminated the natural competition between the telegraph and telephone, so far as these companies are concerned, they contemplate absolutely wiping out all competition whatsoever in hundreds and perhaps thousands of small towns in the United States.

Westinghouse Orders.—The Cleveland, Painesville & Eastern Railroad Company, of Willoughby, Ohio, which is enlarging its plant and changing the operating voltage from 13,200 volts to 22,000 volts, has ordered two 1500-kw and two 50-kw, 6600-volt turbo-generator units from the Westinghouse Machine Company. The Indiana County Street Railway Company, of Indiana, Pa., has ordered one 625-kva Westinghouse-Parsons turbo-generator, with Le Blanc condenser, for installation in its plant at Twolick, Pa. The turbo unit will feed into the 6600-volt, three-phase, 60-cycle lines the company is operating at the present time. A little over a year ago the Westinghouse company built and installed two 3000-kw, 25-cycle, six-phase, 600-volt rotary converters at substations of the Interborough Rapid Transit Company, New York, replacing two 1500-kw rotary converters. The 3000-kw machines occupy the same floor space as the smaller ones and the output of the stations has been doubled. Since these units were purchased seven more of the same type have been ordered by the Interborough company. The following 3000-kw rotary converters have either been shipped or are on order: For the Brooklyn Rapid Transit Company, Brooklyn, N. Y., three units; for the Chicago Railways Company, Chicago, two units; for the Philadelphia Rapid Transit Company, Philadelphia, Pa., two units, and for the Metropolitan Street Railway Company, Kansas City, Mo., one unit.

Meeting of Idaho Cedarmen's Association.—The Idaho Cedarmen's Association met on Nov. 7, in Spokane, Wash., and took action on several matters of interest, among others the adoption of a standard list of weights of poles. In the past it has been the custom for each concern to use its own weights, and it was deemed advisable to adopt a standard similar to that of the Eastern cedar dealers. A committee on publicity was appointed by the president, consisting of J. C. Davis, of the Humbird Lumber Company; H. C. Culver, of the Sand Point Lumber & Pole Company, and R. L. Bayne, of the Lindsley Brothers Company, to look into the matter of securing a greater publicity for the merits of the Western cedar poles. Pole consumers, especially those in the East and South who have never used the Western poles, are unfamiliar with them and with the claims that the Western cedar is straighter, more symmetrical, has less butt rot and is stronger by tests made by the United States Forestry Service than any other pole material on the market of equal lasting power. It is to correct this situation that the committee was appointed, and steps will be taken at once to secure greater publicity for the merits of the Western pole.

Orders for Taylor Stokers.—The American Ship Windlass Company, manufacturer of the Taylor stoker, reports recent orders as follows: From the Hartford Electric Light Company, for two stokers; from the New York, New Haven & Hartford Railroad Company (Bridgeport plant), for two stokers; from the Solvay Process Company, for one stoker; from the Columbia Shade Cloth Company, for three stokers for its plants at Chicago and Minetto, N. Y., and from the Fisk Rubber Company, for one stoker. The first three of these are repeat orders.

Field for Electrical Apparatus in Argentina.—The American Consulate-General at London states that a British publication reports a good demand in Argentina for all kinds of electrical apparatus in connection with lighting, heating, locomotion, telegraphy, telephony and motive power, particularly for generators working at 110 volts and 65 volts. There are also good openings for continuous-current motors and fans. Further details can be obtained by applying to the Bureau of Manufactures, Washington, D. C., for Schedule 7563.

Panama Canal Motors.—A contract for trial motors for the miter gate-forcing machines to be used on the locks of the Panama Canal has been awarded to the Allis-Chalmers Company. If these motors prove satisfactory upon test forty-two additional machines may be purchased.

Terry Steam Turbine Company.—Among the foreign orders recently received by the Terry Steam Turbine Company, 90 West Street, New York City, is one for three turbine-driven blowers for Chinese cruisers and one for a 15-kw turbo-generator set for Russia.

Financial.

THE WEEK IN WALL STREET.

PUBLIC interest in the stock market is increasing steadily, due to growth of confidence in general business, with the result that conditions on the New York Stock Exchange are assuming a more cheerful aspect than has been the case for some weeks past. Prices are somewhat irregular, and the advances of the preceding week have not been sustained. There was very little in the day's news to stimulate the market on Monday, and a decline took place in both prices and volume of trading. Selling of Steel shares was the chief feature of the day, and reports of growth of traffic earnings seemed to be the only topic of any importance, indicating improvement in general trade. Irregularity was the characteristic of Tuesday's market. Declines took place in the early trading, and were followed by partial recovery upon announcement of details of the Commerce Court's decision holding the long-and-short-haul ruling of the Interstate Commerce Commission to be constitutional. The best prices of the day were made toward the close. The extent to which tariff legislation and the Sherman law will be taken up by Congress is a leading item of discussion in the Street. Demand for bonds is improving, and many offerings are attracting the investing public. Present conditions abroad indicate that the large foreign banks will enter the local money market for short-term loans before long, in order to meet large settlements that will be falling due before the end of the year. There is comparatively little demand made upon the local market for funds at present, and no appreciable change has taken place in rates since last week. Rates Nov. 14 were: Call, 2¼@2½ per cent; ninety days, 3@3½ per cent. The quotations in the tables are those at the close Nov. 14.

NEW YORK.

	Nov. 8.	Nov. 14.	Shares Sold.		Nov. 8.	Nov. 14.	Shares Sold.
All. Ch.....	3⅛*	3½	900	Int. Met., pf.	45½	44	6,060
All. Ch., pf...	11	13¼	1,000	Mackay Cos..	85*	85½*	300
Amal. Cop...	54½	58⅞	91,670	Mackay C.,pf.	73*	73⅝	100
Am. D. T....	33⅛*	33⅛*	———	Man. Elev...	136*	135	215
Am. Loco....	33	35	3,670	Met. St. Ry.	15*	15*	———
Am. Loco., pf.	102⅛	103¾*	640	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	78*	78*	———	Steel, com...	58½	62⅛	1,286,400
Am. T. & T..	138¼	139	19,246	Steel, pfd....	107¼	109¼	26,900
B. R. T.....	77½	78¼	26,430	W. U. T....	78½	77¼	6,900
Gen. Elec....	151½	153	4,400	West'h. com.	65¾*	66	4,400
Int. Met.....	14½	14½	8,300	West'h. pfd.	115*	115*	100

PHILADELPHIA.

	Nov. 8,	Nov. 14.		Nov. 8,	Nov. 14.
Am. Rys.....	44	45	Phila. R. T.....	23⅜	23
El. Co. of A.....	12	12	Phila. Elec.....	16½	16⅛
Elec. St. Bt'y.....	52⅞	53½*	Phila. Trac.....	84⅜	84½*
Elec. St. Bt'y, pf...	30*	30*	Union Trac.....	51¼	51¾

CHICAGO.

	Nov. 8,	Nov. 14.		Nov. 8,	Nov. 14.
Chi. City Ry.....	186*	186*	Com. Edison.....	132	132½
Chi. Elev. Rys.....	29*	30	Chi. Subway.....	1	¼
Chi. Elev. Rys., pf..	92¼	93	Chi. Telephone.....	122*	123*
Chi. Rs., Ser. 1....	98	96*	Nat'l Car.....	104*	105*
Chi. Rs., Ser. 2....	34	33	Nat'l Car, pf.....	119*	118*

BOSTON.

	Nov. 8,	Nov. 14.		Nov. 8,	Nov. 14.
Am. T. & T.....	138	138¾	Mex. Tel.....	3	3*
Cum. Tel.....	155	152	Mex. Tel., pf.....	6	6½*
Edison	292*	291	N. E. Tel.....	145½	148⅛
Gen. Elec.....	152⅛	153½	W. T. & T.....	27½	27½*
Mass. E. Ry.....	22	21	W. T. & T., pf.....	107¼	107¼*
Mass. E. Ry., pf....	94	93¾			

*Last price quoted.
Shares sold for the week Nov. 6 to Nov. 11.

FINANCIAL NOTES.

Public Service Company of Northern Illinois.—A notable addition to the electric-service companies of the country has been made by the appearance of the Public Service Company of Northern Illinois, incorporated under the laws of Illinois, which on Nov. 11 acquired the business and properties of a number of central-station companies operating within a radius of about 100 miles from Chicago. As announced in previous issues of the *Electrical World*, the plan has been in contemplation for some time, and the new company was incorporated several weeks ago. The names of the companies absorbed and their capital-stock issues are as follows: North Shore Electric Company, $5,000,000; Chicago Suburban Light & Power Company, $2,300,000; Economy Light & Power Company, $3,000,000; Illinois Valley Gas & Electric Company, $4,013,000 (preferred, $763,000, common, $3,250,000); Kankakee Gas & Electric Company, $1,000,000. Thus the total capital stock of these companies was $15,313,000. In return for the stock holdings enumerated in the foregoing list the owners of the stock of the old companies received from the new company $763,000 of 6 per cent preferred stock and $9,062,500 of common stock, making a total issue of new stock of both kinds of $9,825,500. In addition to this, the Public Service Company has in its treasury $500,000 of preferred stock and $1,000,000 of common stock. The capital stock of the new company distributed to stockholders is $5,487,500 less than the combined issued capital stock of the acquired properties. This is a rather remarkable fact, as frequently in combinations of this character the new issue is larger than the old one. It should also be mentioned that all shares of stock of the old companies, held by 748 shareholders, were voted in favor of the plan carried out. The properties were purchased subject to the existing bond issues of the several companies, which issues will now be closed. It is understood that a new first and refunding mortgage will be placed upon the merged properties. The bonds ($1,250,000) on the Illinois Valley Gas & Electric Company's property and the short-time notes ($2,000,000) issued against the Chicago Suburban Light & Power Company's property will be retired, the former at once and the latter on Feb. 1, 1912. The new company has sold $4,500,000 5 per cent first and refunding bonds, which will be devoted to acquiring the Illinois Valley Gas & Electric Company's bonds and the Chicago Suburban Light & Power Company's notes, and $1,250,000 of the bonds of the North Shore Electric Company and the Kankakee Gas & Electric Company, so that the entire amount of first and refunding bonds now sold by the new company will be used for refunding purposes. It is expected that the immediate future financing necessary to develop the new company's business will be done by the issue of additional preferred stock. The new company is authorized to issue $10,000,000 of preferred stock and $15,000,000 of common stock. The main office of the Public Service Company of Northern Illinois will be at 137 South La Salle Street, Chicago, where the offices of the North Shore Electric Company have been located. The North Shore company operated in the suburban area and rural communities north, west and south of Chicago. The Chicago Suburban Light & Power Company, of Oak Park, has been affiliated with it. The Economy Light & Power Company had its headquarters in Joliet, while the Illinois Valley Gas & Electric Company was farther west and south, Streator being one of its principal cities. The Kankakee company gave service in Kankakee and vicinity, 56 miles south of Chicago. The North Shore and Illinois Valley companies were the results of the absorption of a large number of small properties. The great new company is the outgrowth of a combination of many small companies with limited credit into one large concern with excellent credit. Samuel Insull, who was president of the North Shore, Economy and Illinois Valley companies, is the man who has brought about this result, which seems to typify a modern economic tendency. The business of the new company extends over a large portion of northern Illinois and embraces the distribution of electrical energy, gas, water, heating and the operation of a small street railway. The company has steam generating stations at Evanston, Waukegan, Oak Park, Maywood, Blue Island, Joliet, Kankakee, Streator, Lacon, Henry, Grand Ridge and Cornell, and water-power plants at Joliet, Kankakee and Wilmington. It has gas plants at Kankakee, Streator, Ottawa and Morris; waterworks at La Grange, Harvey and Oak Park; heating plants at Oak Park, Evanston and Waukegan, and the local street railway at Streator. It operates in over 100 different cities and villages and serves a population of about 366,000 people. It is estimated that the business for the coming year will exceed $3,500,000. The directors of the Public Service Company of Northern Illinois are Messrs. Frank J. Baker, Henry A. Blair, H. M. Byllesby, Louis A. Ferguson, William A. Fox, John F. Gilchrist, Samuel Insull, Frank G. Logan, Charles A. Munroe, John L. Norton, Charles H. Randle, Edward P. Russell and Solomon A. Smith. The officers are as follows: President, Samuel Insull; vice-presidents, Frank J. Baker and Charles A. Munroe; assistant to the presi-

dent, John F. Gilchrist; secretary and treasurer, John H. Gulick; assistant secretary and assistant treasurer, E. D. Alexander; auditor, A. S. Scott; general superintendent, George H. Lukes.

Standard Gas & Electric Company's Bonds Offered.—New York interests are offering $7,500,000 convertible 6 per cent sinking-fund gold bonds of the Standard Gas & Electric Company, which was organized in 1910 by H. M. Byllesby & Company, of Chicago, and owns stocks, bonds and other securities of fourteen public-service corporations situated in various parts of the country. These companies, operating in the States of Washington, Oregon, Idaho, Montana, California, Colorado, North Dakota, Minnesota, Wisconsin, Iowa, Oklahoma, Arkansas and Alabama, are, for the most part, under the direction of H. M. Byllesby & Company. The bonds now offered are dated Dec. 1, 1911, are due Dec. 1, 1926, and are secured by deposit and pledge with the trustee of securities of the underlying operating companies, with an approximate market value of $20,000,000. The capitalization of the Standard Gas & Electric Company upon the retirement of its $3,000,000 convertible 6 per cent bonds dated May 2, 1910, and its $1,850,000 6 per cent collateral trust notes, dated June 1, 1911, both of which issues have been or will be called for redemption, will consist of an authorized issue of $30,000,000 6 per cent sinking-fund gold bonds (present issue), with $7,500,000 outstanding; $30,000,000 preferred stock, paying 8 per cent, with $9,196,800 outstanding, and $15,000,000 common stock, with $7,468,150 outstanding. The convertible 6 per cent sinking-fund gold bonds are convertible at any time before maturity at the option of the holder into preferred stock of the Standard Gas & Electric Company on a basis of $110 of bonds for $100 of preferred stock, and are redeemable as a whole or in part at 105 and accrued interest on any interest day on sixty days' notice. Net income of the operating companies for the year ended Sept. 30, 1911, applicable to the securities now held by the Standard Gas & Electric Company was equal to about three and one-half times the $450,000 interest on these bonds.

Milwaukee Electric Railway & Light Company to Issue $90,000,000 Bonds.—The North American Company, New York, which controls the Milwaukee Electric Railway & Light Company, has announced that the Milwaukee company will execute a mortgage to cover a $90,000,000 bond issue, the proceeds of which will be used as needed to meet payments on improvements made and contemplated by the company. The statement of the North American Company concerning these bonds is as follows: "The Milwaukee Electric Railway & Light Company has had under consideration for some time past the execution of a new mortgage having an authorized issue of $90,000,000, a part of which is to be reserved to retire underlying bonds as they may become due, and the proceeds from the balance of which are to be used in part payment for improvements recently made and to be made in the future. This authorized issue of bonds has no relation to any other company than the Milwaukee Electric Railway & Light Company, and it is not the intention to effect a consolidation with the Milwaukee Electric Railway & Light Company of the other Wisconsin properties in which the North American company is interested. The issue of bonds under the proposed mortgage is subject to the approval of the Railroad Commission of Wisconsin." About $2,500,000 of these bonds, it is said, will be issued by the company very shortly and will be offered for sale by New York bankers.

Earnings of Pacific Telephone & Telegraph Company.—Gross earnings of the Pacific Telephone & Telegraph Company for the nine months ended Sept. 30, 1911, showed a gain of $983,225 and the surplus showed a decrease of $109,835 as compared with the corresponding items in the nine months ended Sept. 30, 1910. The gross income for the period was $11,326,724, as compared with $10,343,499, and operating expenses were $8,720,168, as compared with $8,067,404. Net earnings were $2,606,556, as against $2,276,095. Charges for the period were $1,639,182 and those in the 1910 period were $1,204,136, leaving surpluses available for dividends of $967,374 and $1,071,959 respectively. Dividends were $815,250, as compared with $810,000, and the surplus for the period was $152,124, as compared with $261,959 in the nine months ended Sept. 30, 1910.

Cumberland Telephone & Telegraph Company.—James E. Caldwell, president of the Cumberland Telephone & Telegraph Company, of Nashville, Tenn., has announced that arrangements have been completed to exchange stock of the Cumberland company for that of the American Telephone & Telegraph Company. Since the latter has held 51 per cent of the Cumberland company's stock since its formation, absorption by the Bell interests is indicated. The Cumberland Telephone & Telegraph Company operates in Kentucky, Tennessee, southern Indiana, Mississippi and Arkansas, and has a capital of $20,200,000.

Macon (Ga.) Railway & Light Company Sold.—Controlling interest in the Macon Railway & Light Company, of Macon, Ga., has been purchased by A. B. Leach & Company, bankers, of 149 Broadway, New York City, who are the principal owners of the Central Georgia Power Company. The company has 12,000 shares of stock outstanding, of which 3000 are preferred. The purchasers gave $732,000 for 6100 shares. Most of these were owned by W. J. Massee, president of the Macon company; by M. F. Hatcher, its vice-president, and by J. T. Moore and J. N. Neel.

Rochester Railway & Light Company to Issue Bonds.—The Public Service Commission for the Second District of New York has authorized the Rochester Railway & Light Company to issue $1,998,000 of its 5 per cent gold mortgage bonds dated July 1, 1904, and due July 1, 1954. These bonds are to be issued in exchange, par for par, for 5 per cent bonds of the Rochester Gas & Electric Company, due Nov. 1, 1912, as such bonds can be acquired by the Rochester Railway & Light Company.

Montreal Traction Merger Effected.—The negotiations toward an amalgamation of the Montreal Street Railway Company and the Montreal Tramways, mentioned in these columns Oct. 21 and 28, have been successful and the application of these companies to consolidate under the name of the Montreal Tramways Company has been approved by the Public Utilities Commission at Montreal.

Boston Edison's October Business.—The report of the Edison Electric Illuminating Company of Boston for the month of October shows gross earnings of $478,310, as compared with $427,636 in October, 1910. Expenses were $194,395, as compared with $183,855, and net earnings were $283,915, as compared with $243,781 in the corresponding month in 1910.

Earnings of Ohio Traction Companies.—Gross earnings of all the traction companies in the State of Ohio in the year ended June 30, 1911, as shown in the report of the Tax Commission at Columbus, Ohio, were $35,739,794, as against $33,143,852 in 1910, an increase of $2,595,942.

DIVIDENDS.

American Railways Company, quarterly, 1½ per cent, payable Dec. 15.

Georgia Railway & Electric Company, quarterly, 2 per cent, payable Nov. 20.

Northern Ohio Traction & Light Company, quarterly, three-fourths of 1 per cent, payable Dec. 15.

St. Joseph (Mo.) Railway, Light, Heat & Power Company, quarterly, one-half of 1 per cent, payable Dec. 1.

REPORTS OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
BLACKSTONE VALLEY GAS & ELECTRIC COMPANY.					
Sept., 1911.....	$92,974	$42,889	$50,085	$31,464	$19,621
Sept., 1910.....	89,614	42,577	47,037	30,380	16,657
COLUMBUS ELECTRIC COMPANY.					
Sept., 1911.....	$41,816	$20,682	$21,134	$10,262	$10,872
Sept., 1910.....	39,236	16,710	22,526	17,908	4,618
DALLAS ELECTRIC CORPORATION.					
Sept., 1911.....	$131,249	$83,301	$47,948	$25,605	$22,343
Sept., 1910.....	119,804	75,538	44,266	26,014	18,252
EL PASO ELECTRIC COMPANY.					
Sept., 1911.....	$56,962	$31,514	$25,448	$8,340	$17,108
Sept., 1910.....	54,846	30,383	23,463	8,215	15,248
GALVESTON HOUSTON ELECTRIC COMPANY.					
Sept., 1911.....	$130,685	$75,550	$55,135	$25,468	$29,667
Sept., 1910.....	110,145	63,308	46,837	26,199	20,638
NORTHERN TEXAS ELECTRIC COMPANY.					
Sept., 1911.....	$136,089	$71,382	$64,707	$25,399	$39,308
Sept., 1910.....	118,192	61,594	56,598	19,689	36,909
PUGET SOUND ELECTRIC RAILWAY.					
Sept., 1911.....	$152,034	$91,218	$60,816	$51,643	$9,173
Sept., 1910.....	160,544	98,607	61,937	51,974	9,963
SAVANNAH ELECTRIC COMPANY.					
Sept., 1911.....	$58,428	$40,119	$18,309	$18,307	$2
Sept., 1910.....	51,598	32,606	18,992	18,157	835
SEATTLE ELECTRIC COMPANY.					
Sept., 1911.....	$443,639	$241,132	$202,507	$115,627	$86,880
Sept., 1910.....	481,157	274,704	206,453	110,933	95,520
SIERRA PACIFIC ELECTRIC COMPANY.					
Sept., 1911.....	$49,384	$20,136	$29,248	$4,377	$24,971
Sept., 1910.....	47,544	14,325	33,219	6,020	27,199
TAMPA ELECTRIC COMPANY.					
Sept., 1911.....	$56,840	$30,182	$26,658	$6,384	$20,274
Sept., 1910.....	44,969	23,910	21,059	6,018	15,041

General News

Construction News.

BIRMINGHAM, ALA.—The Southern Railway, it is reported, is contemplating extending its telephone system between Chattanooga and Knoxville, on the Knoxville division, a distance of 111 miles. B. Herman, 1300 Pennsylvania Avenue N. W., Washington, D. C., is chief engineer.

RAGLAND, ALA.—The Board of Aldermen has granted to Frank M. Morris and associates franchises to install and operate an electric-light and power plant, a gas-lighting and fuel plant and a street-railway franchise. Mr. Morris is given from five to seven years to carry out his obligations. In return for the franchise he agrees to pay the town of Ragland 2½ per cent of the net income from all sources and also to furnish considerable free service in the way of electricity, fuel, etc.

VALDEZ, ALASKA.—Plans are being prepared by the Gold Bullion Mining Company for the erection of a large electric-power plant to supply electricity to operate its mines. William Bartholf is manager.

GLOBE, ARIZ.—The Inspiration Copper Company is planning to erect a private telephone system from Pinal Creek to its mines, a distance of about 18 miles. C. H. Repath is consulting engineer.

PHOENIX, ARIZ.—James E. Barker, engineer, of Los Angeles, Cal., engaged by the City Council to investigate the local electric-light system, has submitted a report recommending the establishment of a municipal electric-light plant, purchasing energy from the high-tension system of the Reclamation Service at not over 2 cents per kw-hour. The city's contract with the Pacific Gas & Electric Company has expired, although the company still holds an agreement to install a street-lighting system at a cost of $20,000.

ASHDOWN, ARK.—The City Council has granted the Texarkana Ice Company a twenty-five-year franchise to operate an electric-light system in Ashdown. The council also agrees to contract for street lighting, to cost $1,000 per year. The rate for arc lamps will be $8 each per month. The rate for commercial lighting will be $1 per month for one lamp, $1.50 for two lamps and 75 cents per month for each additional lamp. The charge for meter service will be 15 cents per kilowatt for the first 50 kw, 12 cents for the next 50 kw and 10 cents for all over 100 kw, with a minimum charge of $1 per month.

EARLE, ARK.—The City Council has granted franchises to James Z. George, of Memphis, Tenn., to construct and operate an electric-light plant and water-works system in Earle. The city formerly owned the water-works, but sold the entire system to Mr. George, who proposes to enlarge and improve the same. Through oversight this item appeared under Earle, Kan., in the issue of Nov. 11.

BRAWLEY, CAL.—The Bernice Water Company, recently incorporated with a capital stock of $450,000, is preparing plans for the erection of a hydroelectric-power plant on the Alamo River. W. H. Best and Frank Salisbury are directors of the company.

COALINGA, CAL.—The Coalinga Water & Electric Company is planning to extend its transmission lines into the East Side fields, via Pleasant Valley district, to supply electricity for operating pumps for irrigating purposes.

COLTON, CAL.—The Southern California Edison Company has been awarded the contract for street lighting in Colton.

FAIR OAKS, CAL.—The Stockton Electric Railroad Company, it is reported, is contemplating extending its system into Fair Oaks.

FORESTVILLE, CAL.—The Petaluma & Santa Rosa Electric Railway Company is contemplating extending its system from Forestville to Healdsburg, a distance of about 15 miles.

FULLERTON, CAL.—The Standard Oil Company, it is said, is planning to install an electric-light plant on its oil properties near Fullerton.

GROVELAND, CAL.—The installation of new electric hoisting machinery at the Slap Jack Mine is under consideration. Richard Pierce is manager.

HUNTINGTON PARK, CAL.—It is reported that an election will be held on Nov. 28 to submit the proposition to issue $110,000 in bonds, the proceeds to be used for the construction of a municipal electric-light plant and water-works system and to provide for fire protection, to a vote of the people.

LAKEPORT, CAL.—Preparations are being made by the Clear Lake Railway Company, recently incorporated, to construct an electric railway from Lakeport to Hopland, a distance of about 9 miles.

LOS ANGELES, CAL.—The Fire Commission has instructed its superintendent to provide for the installation of a private telephone system at San Pedro Harbor, to be used in connection with the salt-water service and fireboats.

LOS ANGELES, CAL.—The Pacific Light & Power Company has taken out a permit to make alterations and improvements to its power plant on East Third Street. Contract for the work has been awarded to the Mersereau Bridge & Construction Company, of Los Angeles, Cal.

LOS ANGELES, CAL.—The Pacific Light & Power Corporation has filed papers with the county clerk authorizing a bond issue of $35,000,000. Of this amount $9,000,000 will be used to guarantee the underlying bonds of the company, and the remainder for the construction work in connection with its proposed power plant on Big Creek, San Joaquin Valley, and for extension of its transmission and distributing system in Los Angeles and vicinity.

MADERA, CAL.—The Pacific Telephone & Telegraph Company is planning to remove its poles on Yosemite Avenue from B to H Street and will install an underground conduit system, the cost of which is estimated at $10,000.

MADERA, CAL.—Plans are being considered by the Madera Canal & Irrigation Company for the installation of a hydroelectric power plant to supply electricity for operating pumps in connection with its large irrigation project. The cost of the work is estimated at $5,000,000. I. Tellman, of Fresno, Cal., engineer, is interested in the company.

NAPA, CAL.—Preparations are being made by the Napa Gas & Electric Company for extensive improvements to its system in Napa.

OAKLAND, CAL.—The Oakland & Antioch Electric Railway Company has executed a mortgage in favor of the Union Trust Company. The mortgage covers all the property of the company extending from Oakland to Antioch and Stockton. Bonds issued under this mortgage will be used for construction work.

ORANGE, CAL.—The Board of Trustees has entered into a contract with the Southern California Edison Company for the installation of 100 additional tungsten lamps in connection with the street-lighting system.

ORDWAY, CAL.—Preparations are being made to enlarge and improve the power plant of the Ordway Electric Light & Power Company, involving an expenditure of about $7,000. A twenty-four-hour service will be established soon after the first of the year.

POMONA, CAL.—Plans are being considered by property owners on South Thomas Street, between First and Fifth Streets, for the installation of an ornamental street-lighting system at their own expense.

PORTERVILLE, CAL.—Owing to the new regulations adopted by the Underwriters of the Pacific and the new regulations which have been made obligatory upon light and power public-service corporations through new legislation which went into effect Oct. 22, the Mount Whitney Power Company will be obliged to rebuild its entire distributing system within five years. The company is preparing to erect ornamental lamp standards on Sunnyside Avenue.

RED BLUFF, CAL.—The Sacramento Valley Power Company is contemplating extending its transmission lines from the Cofer district to Jelly's Ferry to supply electricity for dredging purposes.

SACRAMENTO, CAL.—The Board of City Trustees has granted the Sacramento Electric Gas & Railway Company a franchise to build an electric railway on Third, E. K and T Streets. Under the terms of the franchise the company is to pay the city 2 per cent of its gross receipts after the first five years. The agreement also calls for the erection of ornamental iron poles and grooved rails.

SAN BERNARDINO, CAL.—A deal has been closed whereby the Southern Sierras Power Company has purchased the property of the Lytle Creek Power Company in San Bernardino. The price paid for the plant is said to be $160,000. The Southern Sierras Power Company has awarded the contract for the erection of distributing lines in Riverside and San Bernardino Counties to H. M. French, of Los Angeles, Cal. It is understood that the system of the Lytle Creek Power Company will be used as a nucleus for a complete distributing system in San Bernardino and surrounding country.

SAN DIEGO, CAL.—The Home Telephone Company is contemplating the erection of three new trunk lines to El Cajon and four new lines to La Mesa.

SAN FRANCISCO, CAL.—The Board of Public Works has awarded a contract for furnishing lighting fixtures for the Hall of Justice to Adams & Holopeter, of San Francisco, Cal., for $14,395.

SAN FRANCISCO, CAL.—The contract for electrical work for the new hotel and theater building for the Down Town Realty Company has been awarded to A. E. Brooke Ridley and the Metropolitan Construction Company, for $8,462.

SAN FRANCISCO, CAL.—The property of the San Francisco, Vallejo & Napa Valley Electric Railway Company was purchased at public auction on Oct. 30 by the bondholders' reorganization committee for $700,000. The company will be reorganized and will operate the system, which extends from Benicia to St. Helena, a distance of 30 miles.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company has announced that it proposes to enter into competition for lighting contracts in all the bay cities. The steam-power plant of the company at North Beach is said to have an output of $25,000 hp, while the auxiliary plant in Bryant Street generates 3000 hp. The hydroelectric plant on the Stanislaus River has an output of 48,000 hp and

the plant at Sonora has a capacity of 2500 hp. The company is carrying on a campaign for contracts in Modesto, Stockton and Tracy and has recently invaded Berkeley and Oakland. The United Railroads of San Francisco takes 25,000 hp under contract. Both companies are subsidiaries of the United Railways Investment Company.

TAFT, CAL.—The San Joaquin Light & Power Company has signed contracts with the Maricopa Queen Oil Company and the Eagle Creek Company for the installation of electric light and power systems on their leases. Both companies will have their plants lighted throughout with electricity and arrangements are being made to operate the pumps with electricity.

TROPICO, CAL.—E. S. Ayres, Builders' Exchange, Los Angeles, Cal., is reported to have submitted a bid for the installation of an electric-light system in Tropico. It is expected that the Board of Trustees will vote favorably on the proposition.

VENICE, CAL.—Plans are being considered by the Council for the installation of an ornamental street-lighting system, with concrete standards. The standards will be manufactured by the city from designs made by City Engineer Lewis and sold to property owners at cost, which is estimated at about $9 each. Electricity for maintaining the lamps will be supplied by the city.

CANON CITY, COL.—Plans are being considered for organizing a new company under the name of the Arkansas Valley Railway, Light & Power Company, which, it is understood, will be controlled by interests connected with H. M. Byllesby & Company, of Chicago, Ill. It is stated that the company will have charge of the Cañon City property and other interests and plants in the Arkansas Valley. W. F. Raber, E. D. Spruill and F. W. Insull are interested in the project.

FORT LUPTON, COL.—The question of operating the pumps at the new water-works station by electricity instead of a gasoline engine is under consideration. It is now thought that the present engine will not be able to furnish sufficient power.

GREELEY, COL.—The Greeley Hydro-Electric Company, recently incorporated, has taken over the electric-power plant located near the Poudre River and used for boring the Laramie-Poudre tunnel. The new company is capitalized at $700,000 and will utilize 500 hp available from the Laramie River tunnel flow and the natural flow of the Poudre River to supply electricity in Greeley and surrounding territory. At present the plant has an output of 400 hp. The transmission line will be 70 miles in length and will cost $900 per mile. It is expected to have the plant completed by April, 1912. D. A. Camfield, A. J. Condon, D. R. McArthur, W. D. Miller, Frank Abbott, C. A. Fitch and John Camfield are the incorporators.

IDAHO SPRINGS, COL.—Plans are being considered for the construction of an electric-power plant at the Dorritt mine, to supply electricity for lamps and motors for the mine. F. L. Patrick is manager.

ROCKY FORD, COL.—Preparations are being made by H. M. Byllesby & Company, of Chicago, Ill., owners of the Pueblo, Rocky Ford and La Junta electric plants, for the erection of a high-tension transmission line, which is to extend down the valley. F. Y. Lowe is chief electrical engineer of H. M. Byllesby & Company. T. C. Roberts is superintendent of the Pueblo plant.

NEW HAVEN, CONN.—A permit has been granted to the Connecticut Company to construct additions to its power house on Grand Avenue. The additional space will be used as an engine-room. Several new engines and boilers will be installed. The cost of the work is estimated at about $25,000.

SOUTH NORWALK, CONN.—The annual report of the municipal electric-light plant shows a gross profit of $26,417 for the year. A substantial reduction will be made in the rates for both lamps and motors with the beginning of the new fiscal year. The Electric Light Commission is contemplating replacing arc lamps with tungsten lamps in order to extend and improve the street-lighting system without being obliged to make extensions to the plant, which has almost reached the limit of its capacity to generate electricity for the street-lighting service.

BUNNELL, FLA.—An electric-light plant is being installed in Bunnell, which will supply electricity for the entire town. It is expected to have the system in operation within sixty days.

ST. AUGUSTINE, FLA.—The St. Johns Electric Company, recently incorporated, will take over the property of the St. Johns Light & Power Company, including the local electric-light and power plant and street-railway system. It is expected that the new management will make improvements to the power plant and extensions to the street-car service. The officers of the new company are: W. M. Bostwick, Jr., of Jacksonville, president; O. H. P. Fant, of St. Augustine, vice-president, and B. E. Dyson, of St. Augustine, secretary and treasurer.

BAXLEY, GA.—The $15,000 bond issue recently voted by the citizens for the installation of a municipal electric-light plant has been validated. The Lyon Electric Company, of Jacksonville, Fla., has been engaged to supervise the work.

LA FAYETTE, GA.—The Georgia Power Company is contemplating erecting a transmission line to Lyerly, Summerville, La Fayette and Chickamauga.

MACON, GA.—The Georgia Light, Power & Railways Company is reported to have purchased the controlling interest of the Macon Railway & Light Company, the property of the Central Georgia Power Company, and will also own the stock of the Central Georgia Gas Company. Application has been made to the Council for a franchise. The company is also planning to erect a transmission line for the Georgia power company from its present terminal in Griffin, Ga., into Atlanta.

MARSHALLVILLE, GA.—The contract for the installation of an electric-light plant and water-works system in Marshallville has been awarded to J. C. Walker.

TOCCOA, GA.—It is reported that the Capps Cotton Mill Company is contemplating the construction of another dam on upper Toccoa Creek for power purposes. The company purposes to equip its plant for electric-motor drive. It is understood that motors have already been purchased.

BOISE, IDAHO.—The Idaho-Oregon Light & Power Company has taken over the property of the Boise Valley Railway Company. The transaction is said to involve about $1,000,000. Interests representing the Beaver River Power Company and the Telluride Power Company are said to be identified with the interest backing the consolidation.

BOISE, IDAHO.—Proposals will be received by the Crane Falls Power & Irrigation Company for construction of dam, power house and pumping station on the Snake River in Southern Idaho until Dec. 10. Plans and specifications may be seen after Dec. 1 at the offices of Smith, Kerry & Chace, Lewis Building, Portland, Ore., and Winch Building, Vancouver, B. C., and also at the office of the company at Boise, Idaho. The company will arrange for its representative to accompany responsible contractors to the site of the works near Mountain Home and Caldwell.

DIXIE, IDAHO.—The Idaho Realty, Power & Mines Company is contemplating the installation of an electric-power plant in Dixie, with a local distributing system. S. R. Gayton is manager.

WALLACE, IDAHO.—The Washington Water Power Company is extending its transmission line to the Sunset country. It is believed that the line will eventually be extended to Murray and the north side. The company has commenced work on clearing its right of way for its proposed transmission line into the Cœur d'Alene district. The line will be 130 miles in length and will serve many of the mining properties in this district.

ALEDO, ILL.—The Central Union Telephone Company is contemplating the erection of a toll line between Aledo and New Boston. A. J. Beverlin, of Rock Island, Ill., is manager.

BATAVIA, ILL.—The Chicago Telephone Company, it is reported, is contemplating the construction of a new exchange building in Batavia, at a cost of $40,000, and the installation of a new switchboard, costing $16,000.

CHAMPAIGN, ILL.—The City Council has ordered a special election to be held Dec. 12 to submit to a vote of the people the proposition to issue $35,000 in bonds, the proceeds to be used for the installation of a new electric-light plant to be owned and operated by the municipality.

DIXON, ILL.—The Lee County Lighting Company has announced a reduction in rates for electricity to take effect from Nov. 1, amounting to practically 20 per cent. Under the new schedule the rate for the first 100 kw-hours is 12 cents per kw-hour; the second 100 kw-hours, 9 cents, and the third 100 kw-hours, 7 cents. Some alterations to the service will be made. A contract has been tentatively agreed upon between the City Council and the company which calls for the installation of 60-watt tungsten lamps in the residence district and new magnetite direct-current, 4.4-amp. arc lamps in the business section. Under the terms of the contract the city will pay $70 each per year for arc lamps and $16 per year for tungsten lamps, with all-night service. The contract is for a period of five years and will necessitate the rebuilding of many circuits.

GALESBURG, ILL.—The Purington Paving Brick Company, it is reported, will install electric transfer trucks throughout its entire plant.

GENEVA, ILL.—The City Council has authorized the city clerk to advertise for bids for equipment (60-cycle system) for the municipal electric-light plant. The proposed apparatus will include a new engine, boiler and generator, to cost approximately $18,000.

GENEVA, ILL.—F. B. Kendrick, of the MacMillan Company, has notified the City Council that it will not be able to utilize more than 150 hp of the 250 hp to be developed by the water-power at its factory, and has asked the city to aid in disposing of this surplus, either by taking it for municipal use or by granting the company a franchise to sell electricity. The MacMillan Company has employed City Engineer Wells to make a survey of the city streets with a view of seeking a contract to supply energy to light the streets of the city.

GEORGETOWN, ILL.—The Georgetown Electric Light Company has petitioned the City Council for a ten-year extension of its franchise, which has five years to run. The company is contemplating substituting tungsten lamps for the arc lamps now in use for lighting the streets.

LA SALLE, ILL.—The report submitted by D. W. Mead, of Madison, Wis., engineer, engaged by the City Council to investigate the municipal electric-light plant, states that the plant is antiquated and its operation inefficient and unsatisfactory, and also that the whole electrical generating equipment and the arc lamps must be replaced at an early date by more modern apparatus. He recommends the installation of magnetite arc lamps and the erection of ornamental lamp standards carrying tungsten lamps for the main streets. Two generators and one new engine and changes in the wiring will be necessary. The cost of the arc-lamp equipment is estimated at $13,424 and that of the incandescent lighting system at $7,700.

MACOMB, ILL.—The Macomb Electric Light & Power Company contemplates extending its transmission line to Colchester to supply electricity in that town. The plant of the Colchester Electric Light & Power Company was recently destroyed by fire.

MATTOON, ILL.—The City Council has authorized the light committee and the Mayor to purchase one new 4-amp Brush arc generator, the cost not to exceed $2,450, and seventy new magnetite arc lamps at a cost of $25 each, bids for which have already been received.

NORMAL, ILL.—The City Council has closed a contract with the Bloomington & Normal Railway & Light Company for lighting the streets of the city for a period of five years.

PEKIN, ILL.—Plans are being considered for the installation of an ornamental street-lighting system in the business district of the city. Seibert Brothers are interested in the project.

PEORIA, ILL.—The Peoria Gas & Electric Company contemplates extending its transmission line now serving Washington to Eureka, Roanoke and Metamora.

PEORIA, ILL.—A proposition has been submitted to the City Council by the River and Lakes Commission of the State of Illinois offering to supply electricity in Peoria at a much reduced rate. The scheme is connected with the proposed deep waterway on the Illinois River and the Des Plaines River. The commission contemplates the transmission of electricity within a radius of 160 miles from the principal power house. It is estimated that energy can be supplied in Peoria at from $15 to $20 per hp per year.

PEORIA, ILL.—The Peoria Gas & Electric Company has secured a permit to erect a transmission line across the Pekin and Lamarsh drainage to supply electricity in Pekin. The company has also entered into a contract with the Lamarsh Drainage Commissioners to supply power to operate the pumping station across the river when the Pekin plant is unable to supply the service. Owing to the increasing demand for electrical service the Citizens' Gas & Electric Company has made arrangements to secure additional power from the Peoria company.

QUINCY, ILL.—The Mississippi Valley Power Company has announced its purpose of establishing a substation in the Walton Heights addition to Quincy for the distribution of electricity generated at the Keokuk dam in Quincy and vicinity.

SAYBROOK, ILL.—The local telephone system has been purchased by Coon Brothers, who operate a telephone exchange at Rantoul, Ill. The two systems will be connected.

SPRINGFIELD, ILL.—The City Commission has awarded to the General Electric Company, of Schenectady, N. Y., a contract for two transformers and fifty magnetite arc lamps, at $2,800.

STREATOR, ILL.—Plans are being considered for the installation of a new street-lighting system in Streator. Two propositions have been submitted by the Illinois Valley Gas & Electric Company. One is to use fifty magnetite arc lamps in the business portion of the city and tungsten lamps for the residential sections. The other plan is to use magnetite arc lamps throughout the city.

BRAZIL, IND.—Preparations are being made by the Terre Haute, Indianapolis & Eastern Traction Company for the installation of ornamental cluster lamps in Brazil. The company recently secured the contract to light the streets of the city.

JONESBORO, IND.—The Town Board is considering the question of changing the present street-lighting system. At present arc lamps are used. The franchise of the Marion Light & Heating Company expired Nov. 1, and the question of granting a new franchise and street-lighting contract is under consideration. The franchise for furnishing electricity for private consumers in Jonesboro is separate from the street-lighting franchise and will not expire for a number of years.

LINTON, IND.—It is reported that plans are being made for the installation of cluster lamps, six to a block, in the business district. Electricity to maintain the lamps will be supplied free of charge from the municipal electric-light plant.

PETERSBURG, IND.—The Evansville Gas & Electric Light Company has submitted a proposition to the City Council asking that the company be granted the franchise which the city will let early in 1912, in return for which the company agrees to supply electricity to the town at rates that will mean a saving of $22,500 in ten years. The Petersburg Electric Light Company now has the franchise, and if it will offer as favorable terms as the Evansville company it will be granted the franchise for another ten years.

PULASKI, IND.—The Central Indiana Water, Light, Heat & Power Company has purchased the dam and water rights in Pulaski. It is proposed to rebuild the dam. The power station will be erected a short distance up the river from the Pulaski mill. Electricity generated at the plant will be transmitted to Star City, Francesville, Medaryville and Monon. An auxiliary power station will be built at Francesville. The company is capitalized at $125,000.

RISING SUN, IND.—Steps have been taken toward the promotion of a traction line to connect Rising Sun with Aurora on the Ohio River, with the ultimate destination of Louisville, Ky., and Cincinnati, Ohio. Local capitalists have been asked to subscribe to $10,000 in capital stock. Raymond Zeisler, of Chicago, Ill., is said to be interested in the project.

SALEM, IND.—The Salem Electric Light & Artificial Ice Company has increased its capital stock by $15,000, the proceeds to be used for repairs, enlarging the plant and installing new equipment.

BOONE, IA.—The Boone Electric Company is reported to have been granted a franchise to install a hot-water-heating plant in Boone.

BOYDEN, IA.—The City Council is reported to have granted a franchise to T. H. and J. J. Veenschoten to install an electric-light plant in Boyden.

BURLINGTON, IA.—The power plant of the People's Gas & Electric Company was damaged by fire on Nov. 5. The lighting system was wrecked and the street-car traffic was suspended.

FORT DODGE, IA.—Plans are being considered to erect a hydroelectric power plant on the Des Moines River, about 15 miles below Fort Dodge. The project is being promoted by Geis Botsford and Mr. Martin, who propose to supply electricty generated at the plant to the city of Fort Dodge. It is estimated that a minimum of 4000 hp could be developed by a 40-ft. dam. The cost of the plant, including an auxiliary steam plant for use in emergencies and during the low-water periods, is estimated at about $600,000.

GLIDDEN, IA.—At an election held Nov. 10 the proposition to issue $10,000 in bonds, the proceeds to be used for the construction of an electric-light plant, was carried. O. B. Moorehouse is clerk.

PILOT MOUND, IA.—The Twogood Construction Company has been granted a franchise to construct and operate an electric light and power plant in Pilot Mound.

VILLISCA, IA.—The Lee Electric Company, of Clarinda, Ia., has applied for a franchise to furnish electricity for lamps in Villisca.

SOLOMON, KAN.—The proposition to issue $30,000 for the installation of an electric-light plant and water-works system was defeated. The bonds were voted last year, but were irregular and declared void.

FALMOUTH, KY.—At an election held recently the citizens voted to establish a municipal electric-light plant in Falmouth.

SOMERSET, KY.—It is reported that the United Water & Light Company is contemplating the installation of an additional engine in its electric-light plant.

HOMER, LA.—The electric-light plant which the town purchased from E. G. Sawyers has been removed to the power house of the water works company.

DOVER, MAINE.—The Greenville Light & Power Company, which recently purchased the property of the Dover & Foxcroft Light & Heat Company, it is understood, will discard the flat-rate system and install meters in all places where electricity is used in both towns.

FREEPORT, MAINE.—Orders have been placed by the Portland & Brunswick Street Railway Company for a motor-generator set so as to utilize electricity from the Brunswick plant to operate the Freeport system.

LEWISTON, MAINE.—The Merchants' Association is considering the question of installing an ornamental street-lighting system in the business district of the city.

BALTIMORE, MD.—The city, it is reported, is contemplating the installation of a plant in the high-pressure pipe-line station on South Street to supply electricity for lighting, heating the city hall and court house. The cost of the plant is estimated at $70,000. H. K. McCay is city engineer.

AMHERST, MASS.—The Amherst Gas Company has applied to the Massachusetts Gas and Electric Light Commission for permission to issue $50,000 in additional capital stock.

GREENFIELD, MASS.—The County Commissioners have approved of the plans for two of the dams to be built by Chace & Harriman on the Deerfield River, subject to the recommendations of James L. Tighe, consulting engineer. The plans approved are for the construction of Dams Nos. 2 and 4, the former to be built 2½ miles down the river from Shelburne Falls, and the latter in the vicinity of Shelburne Falls, between Buckland and Charlemont.

HAVERHILL, MASS.—The Haverhill Electric Company has placed an order for a Westinghouse-Parsons 3350-hp steam turbo generator set for its power plant, located on Water Street.

MALDEN, MASS.—The Malden Electric Company has notified the Street and Water Commission that a reduction will be made in the price of street lamps pending the approval of the new ten-year contract between the city of Malden and the Malden Electric Company. The price of arc lamps is reduced from $100 to $96 each per year, and that of incandescent lamps from $20.30 to $18.30 each per year. This rate applies to the lamps now in use only. The new street-lighting contract has been referred to the Massachusetts Gas and Electric Commission.

WAREHAM, MASS.—Application will be made to the town to appropriate funds for an extension of the electric-lighting system from South Wareham to Haggerty's Corner at Briggs' Lane above Tremont Village.

MENDON, MICH.—At an election held recently the citizens voted to accept the proposition submitted by the town of Sturgis to supply electricity to operate the local system. In 1908 the town voted to appropriate $10,000 to purchase the Parkville dam and water-power, located 6 miles west of Mendon. After spending most of the appropriation in erecting a transmission line and putting in a new flume it was found that sufficient power could not be developed to light the town. It was decided to appropriate an additional $1,000 to complete the project, which was voted down at a special election held about a year ago. It costs about $100 per month above the revenue to operate the present steam plant.

MOUNT PLEASANT, MICH.—Negotiations have been closed whereby the Chippewa River Power Company, of Port Huron, Mich., will take over the plant and holdings of the Harris Electric Company on the first of January. The price paid for the property is understood to be about $25,000. It is expected that the new owners will make improvements and extensions to the system.

MUSKEGON, MICH.—Plans are being considered by the business men on Western Avenue to install cluster lamps on Western Avenue between Pine Street and Union Depot. It is proposed to erect sixty-four clusters between these two points at a cost of about $2,500, the expense to be borne by the business men. The city will be asked to maintain the lamps.

BRAINERD, MINN.—The Board of Water and Light Commissioners is contemplating extending the electric-lighting system to the mill district.

CLARE CITY, MINN.—Application has been made to the City Council by H. Schmidt, of the Peterson-Tetrun Electric Lighting & Battery system, of Dawson, Minn., for a franchise to install an electric light and power plant in Clara City.

FRANKLIN, MINN.—The Wherland Electric Company, of Redwood Falls, Minn., has been granted a franchise to supply electricity in Franklin. It is understood that the company purposes to extend its lines to Franklin in the spring.

HIBBING, MINN.—The Water Power, Light and Building Commission favors acquiring the Brooklyn water mains and the electric-light distributing system owned by A. P. Silliman. The cost of the Brooklyn water mains, etc., is estimated at $13,600 and that of the electric transmission line at $4,000. These estimates do not include the Brooklyn power plant, owned and operated by Mr. Silliman. The commission does not contemplate the purchase of the power plant, but simply to purchase the water mains and electric lines and connect them with the Hibbing system. The total cost of the project is estimated at about $22,000. Brooklyn is in the incorporated limits of Hibbing, having been annexed to this town in April, 1910.

MINNEAPOLIS, MINN.—A proposition has been submitted to the public lighting committee of the City Council by the Minneapolis General Electric Company offering to install at its own expense 150 ornamental street lamps in the railroad passenger-station district, provided the city gives a contract to supply electricity to maintain the lamps at $48 each per year, and that the minimum number of ornamental lamps shall be not less than 565.

RED LAKE FALLS, MINN.—The Red River Power Company is reported to have applied for a new franchise in Red Lake Falls.

SWANVILLE, MINN.—John Stroming, of Swanville, is reported to have purchased the P. W. Blake private telephone line in Lastrup. It is understood that the line will be extended 15 miles.

WINONA, MINN.—Application has been made to the City Council by Howard Morris, receiver of the Winona Railway & Light Company, for permission to make new direct water connection to the company's plant to assure a sufficient water supply at all times. It is proposed to build two large intake mains, at a cost of about $25,000.

LAUREL, MISS.—The Laurel Electric Light & Power Company, recently incorporated with a capital stock of $75,000, will take over the local electric-light plant and street-railway system. P. H. Saunders, S. M. Jones and Herbert Lampe are among the incorporators.

GRANT CITY, MO.—The local electric-light plant is reported to have been purchased by George B. Wilson.

LAMAR, MO.—It is reported that bonds to the amount of $70,000 have been voted, the proceeds to be used for the construction of an electric-light plant and water-works system.

DILLON, MONT.—The City Council is considering the question of installing a new street-lighting system, using cluster lamps in the business district. It is estimated that seventy-lamp standards will be required. The Union Electric Light Company agrees to install the system, provided the property owners furnish the standards. If the system is satisfactory the lamps will be extended to the residence section. At present arc lamps are used.

KALISPELL, MONT.—Contracts have been awarded for the construction of the first section of the Flathead Interurban Railway.

BLADEN, NEB.—Work has commenced on the installation of an electric-light plant in Bladen. Electricity for operating the system will be obtained from the plant in Blue Hill.

GOLDFIELD, NEV.—The Goldfield Belmont Mining Company is planning to install electric hoisting machinery.

RENO, NEV.—Plans are being considered by the Reno Traction Company to build an extension of its electric railway from Sparks to the Arkell mine in the Wedekind district.

TONOPAH, NEV.—The Tonopah Mining Company, operating the Aurora mines, is contemplating the installation of new electric pumping machinery.

ASHUELOT, N. H.—The Public Service Commission has authorized the Ashuelot Electric Company to issue $140,000 in capital stock and has given it permission to purchase the property of the Keene Gas & Electric Company in Ashuelot.

ATLANTIC CITY, N. J.—Plans are being considered by the Atlantic Coast Electric Railroad Company for extending its system through the western part of the State encampment grounds at Sea Girt for the purpose of connecting Manasquan and Sea Girt.

NEWARK, N. J.—Sealed proposals will be received by the Board of Education of Newark, N. J., until Nov. 21 for furnishing energy-transmission machinery and gymnasium apparatus for various school buildings, etc., in accordance with specifications on file in the office of the department of supplies. R. D. Argue is secretary.

WAGON MOUND, N. M.—The Ranchers' Telephone Company, recently incorporated, is planning to install a telephone system in this district. R. K. Odell, S. M. Reiland and S. Foutz are incorporators. Mr. Odell is manager.

ALBANY, N. Y.—Sealed proposals will be received by the Board of Contract and Supply, City Hall, Albany, N. Y., until Nov. 20 for furnishing three 15-kw direct-current turbo generators for the Bureau of Water. Forms of proposals and specifications can be seen at the above office. Isidore Wachman is secretary of board.

BOLTON LANDING, N. Y.—The Bolton Light, Heat & Power Company has received authority from the Public Service Commission, Second District, to issue capital stock to the amount of $12,500, the proceeds to be applied for extensions and improvements to its plant and distributing system.

BUFFALO, N. Y.—The Chippewa Business Men and Taxpayers' Association is considering the question of improving the street-lighting system on Chippewa Street.

DUNDEE, N. Y.—At a special election held recently the citizens voted against the proposition to increase the cost of street-lighting to $2,000 per year. For the last two years the town has paid $1,800 for the service. E. L. Bailey, owner of the local plant, has threatened to discontinue the street-lighting service unless a new contract is made.

LAKEWOOD, N. Y.—The Public Service Commission, Second District, has authorized the Western New York Electric Company to exercise franchises granted it by the village of Lakewood and to begin work on construction of its electric-light plant in that village.

LESTERSHIRE, N. Y.—Steps have been taken by the Board of Aldermen for the installation of a new street-lighting system in Lestershire. The various corporations operating overhead wires have agreed to place them underground on Main Street.

LITTLE FALLS, N. Y.—Two propositions have been submitted to the City Council for lighting the streets of the city by N. R. Holmes, of Troy, N. Y., and H. P. Jones, electrical engineer, of Bennington, Vt. One calls for the city owning its own distributing system, for which they would supply electrical energy at the rate of $30 per lamp per year. The cost of the system is estimated at about $20,000, which would make the street lamps cost about $58 each per year. They also offered to supply street lamps at that price. The Utica Gas & Electric Company recently submitted a bid offering to supply street lamps at $82.13 each per year.

LYONS, N. Y.—Plans are being considered by the Rochester, Syracuse & Eastern Railroad Company to change the location of the pumping station of the power house in Lyons, the cost of which is estimated at about $40,000. The change is made necessary by the barge-canal plans, excavating for which in the vicinity of the power house will soon begin. A temporary station will be erected north of the present power house for use while the permanent station is being built. Ralph Kennard, of Brookline, Mass., electrical engineer, is in charge of the work.

PEARL RIVER, N. Y.—The Rockland Light & Power Company, of Nyack, N. Y., is extending its system to the Pearl River lighting district. It is expected to have the system in operation by Dec. 1.

PULASKI, N. Y.—The corporation having in charge the development of the water-power of the Salmon River has acquired the plant and holdings of the Pulaski Electric Light & Power Company, including a valuable water-power. It is understood that the new company will make extensive improvements to the system. H. Clayton Burkett, present manager of the plant, will be retained.

SENECA FALLS, N. Y.—The Central New York Electric Company is installing an auxiliary plant in Seneca Falls, for use in case of emergencies.

SYRACUSE, N. Y.—The Rochester, Syracuse & Eastern Railroad Company is planning to change the location of the pumping station of its power station located in Lyons.

ELIZABETH CITY, N. C.—The Elizabeth City Electric Light Company is contemplating making improvements to its plant and installing additional machinery. R. E. Lewis is manager.

ANETA, N. D.—The citizens have voted to grant a franchise for the installation of an electric-light plant in Aneta. It is understood that work will begin at once on construction of the proposed plant.

DEVIL'S LAKE, N. D.—At an election held recently the proposition to issue bonds to the amount of $33,000 to be used as a basis for the establishment of municipal light and water plants was carried.

OAKES, N. D.—It is reported that F. L. Kempf, of McVille, N. D., is contemplating the installation of an electric-light plant in Oakes, to cost about $12,000, for which a franchise was recently granted.

PORTAL, N. D.—The Town Board of North Portal is contemplating the installation of an electric street-lighting system.

CLEVELAND, OHIO.—At an election held Nov. 7 the proposition to issue $2,000,000 in bonds for the erection of a municipal electric-light plant was carried.

COLUMBUS, OHIO.—The contract for furnishing iron lamp standards for the cluster-lamp system has been awarded to O'Brien Brothers'

Foundry Company for $24,499. The Erie Company, of Erie, Pa., was awarded the contract for wiring, at $67,505.

CONVOY, OHIO.—The installation of an electric-light plant to be owned and operated by the municipality is under consideration.

DEFIANCE, OHIO.—Steps have been taken by T. T. Ansberry to organize a public utilities company to purchase electricity from the Auglaize River Power Company for distribution in Defiance City and nearby towns. The Auglaize River Power Company expects to develop about 10,000 hp, which it purposes to sell in large quantities to large manufacturing plants or public utilities companies.

GREENVILLE, OHIO.—The capital stock of the Greenville Electric Light & Power Company has been increased from $55,000 to $75,000. The proceeds will be used to erect a transmission line from Greenville to New Madison, Eldorado, West Manchester and Lewisburg.

SALEM, OHIO.—The question of issuing $20,000 in bonds for the installation of an electric distributing system is under consideration.

WILLOUGHBY, OHIO.—The Cleveland, Painesville & Eastern Railroad Company is enlarging its power plant and changing the operating voltage from 13,200 to 22,000. Orders have been placed by the company with the Westinghouse Machine Company for two 1500-kw and two 50-kw, 6600-volt turbo-generator units. The new equipment will furnish energy for the street and interurban system of the company.

OKLAHOMA CITY, OKLA.—Plans are being considered for replacing arc lamps at every other street intersection with tungsten lamps. By this change it is hoped to make a large reduction in the cost of street lighting. The cost of the present system is $32,400 per year and it is expected that the use of tungsten lamps will reduce the cost to about $22,000 per year.

PONCA, OKLA.—Henry A. Braun, of Guthrie, Okla., it is reported, is contemplating the installation of an electric-light plant in Ponca.

BEND, ORE.—The Arnold Irrigation Company contemplates the construction of a telephone system to serve the entire territory in which it operates. W. J. McGillvray is interested in the company.

CRESCENT, ORE.—The Oro del Norte Mining Company is planning to install the Heinz electric flotation process for the extraction of fine gold from sand. The cost of the plant is estimated at $75,000.

EUGENE, ORE.—Bids will be received by the city recorder of the city of Eugene, Ore., until Dec. 11 for the purchase of $57,000 light, power and water bonds. R. S. Bryson is recorder.

GRANT'S PASS, ORE.—M. J. Anderson is at the head of a corporation which proposes to erect a large hydroelectric power plant on the Coquille River in Coos County. A transmission system will be erected to cover the entire territory. The cost of the project is estimated at $1,000,000.

HOOD RIVER, ORE.—The Hydro-Electric Company has submitted an offer to the City Council offering to furnish electricity to light the streets of the city at a rate 50 per cent less than that now charged by the Pacific Power & Light Company, provided the city will enter into a ten-year contract. The company is erecting a large electric plant at Tucker's Bridge, about 6 miles from the city. It is expected to have the plant ready for operation by the first of the year.

LAKEVIEW, ORE.—The Lakeview & Pine Creek Telephone Company has acquired the rural telephone systems at Moss, Chandler, Bunting and Dent. Plans are being made by the company to erect a new line in Goose Valley, a distance of about 20 miles.

MAPLETON, ORE.—Preparations are being made for the erection of a large hydroelectric power plant on the lower Siuslaw River at Swiss Home, about 6 miles above Mapleton, which, it is expected will be completed early next year. Electricity generated at the plant will be transmitted to Mapleton, Florence, Acme and Glendale, where application, it is said, will be made for franchises. Joaquin Miller, George Miller and James Miller are interested in the project.

NEWBERG, ORE.—The County Court has granted the Tualatin Valley Electric Company permission to erect transmission lines along the county road leading from Newberg to Portland, from the crossroads east of Newberg easterly to the county line.

NEWBERG, ORE.—The Yamhill Electric Company has been granted permission by the County Court to erect transmission lines along the Dayton-Portland road from the corporate limits of Newberg to the county line, and along other public roads leading from and into Newberg for a distance of three-quarters of a mile outside of the city limits.

PORTLAND, ORE.—The Ladd Estate Company is planning to install an electrolier lighting system on the new viaduct in the Eastmoreland district.

PORTLAND, ORE.—M. J. Lee, manager of the Canby Canal Company, is at the head of a project to construct an electric railway from Mollalla Valley to Portland, via Canby, a distance of about 30 miles. It is proposed to build a large hydroelectric power plant on the Mollalla River.

SALEM, ORE.—The Portland, Eugene & Eastern Railway Company is reported to be contemplating the construction of an electric railway from Salem to Stayton.

CASSANDRA, PA.—The Borough Council has granted the Penn Central Light & Power Company a franchise to erect and maintain transmission lines throughout the borough.

INDIANA, PA.—A contract has been placed by the Indiana County Street Railway Company with the Westinghouse Machine Company for one 625-kva Westinghouse-Parsons turbo-generator set and one No. 5 Westinghouse Le Blanc condenser to be installed in its plant at Twolick, Pa. This unit will be used to supplement the present equipment of the station. D. H. Clark is president of the company and Frank L. Neff is general manager.

McKEE'S ROCKS, PA.—Preparations are being made by the Pennsylvania Light & Power Company to supply electrical service in McKee's Rocks. The company was recently granted a franchise to supply electricity in this borough.

NATRONA, PA.—Plans are being considered by the Pennsylvania Salt Manufacturing Company for improvements to its plant, including an addition to power plant, reconstruction of the muriatic acid department a new office building, a laboratory, etc., to cost approximately $100,000.

NEW BALTIMORE, PA.—Norman Tupper, owner of the distillery and grist mill, who has installed an electric plant, has decided to offer to furnish electricity to light the town for two months free of charge. The plant will be operated by water-power from the grist mill.

PHILADELPHIA, PA.—Chief McLaughlin, of the Electrical Bureau, in a report to be made to the Director of Public Safety, will recommend that the Councils appropriate $350,000 for improving the lighting system of the city hall and the installation of more modern and safe electric equipment. He will also recommend that during the next five years the city shall annually appropriate $500,000 to replace the obsolete telephone and telegraph equipment connecting police and fire stations.

WHITE, S. D.—The Town Council has granted a franchise to E. A. Harseim, of White, to construct and operate an electric-light system in White for a period of twenty years. Under the terms of the franchise the city reserves the right to purchase the plant at the expiration of five years and each two years thereafter. The system will be installed at once.

CHATTANOOGA, TENN.—Plans are being considered by the City Council to install a conduit system to be rented to public-service companies operating wires on the streets. A. N. Sloan is commissioner of the department of streets.

HELENA, TENN.—The State Mission Board, Tennessee Baptist Convention, it is reported, contemplates the construction of an electric-light plant to supply electricity to light its school building and possibly to the town. The proposed plant will be operated by water-power. For further information address W. L. Riogan, of Helena, Tenn.

SPARTA, TENN.—The plant and holdings of the Sparta Electric Light & Power Company have been purchased by the Anderson-Tubb Power Company. The latter company has been furnishing power to operate the plant of the former for some time. Owing to the City Council and the Sparta Electric Light & Power Company being unable to come to an agreement the city has been without street-lighting service for some weeks.

BEAUMONT, TEX.—It is reported that the Stone & Webster syndicate, of Boston, Mass., is negotiating with the Beaumont Ice, Light & Refrigerating Company for the purchase of the electrical properties of the latter. The consideration is said to be $600,000.

DENISON, TEX.—A special election will be held on Dec. 20 to vote on the proposition to grant a twenty-year franchise to the Southwestern Telegraph & Telephone Company. The company agrees to pay a bonus of $500 per year and also a franchise tax.

SALT LAKE CITY, UTAH.—The Mountain States Telephone & Telegraph Company is contemplating an issue of capital stock to the amount of $2,000,000, the proceeds to be used for further development of its system in this territory. E. B. Field is president of the company.

BURLINGTON, VT.—Plans are being considered for the installation of an isolated electric-light plant of 100 hp in the Hotel Vermont, in Burlington.

BURLINGTON, VT.—In order that the Electric Light Commission may purchase a new 750-kw turbine for the municipal electric-light plant the city has asked that the injunction brought by the Burlington Light & Power Company may be modified so as to allow the purchase of the machinery needed. Last January the Board of Aldermen adopted a resolution authorizing an expenditure of $27,000 for repairs to the municipal plant. The Burlington Light & Power Company immediately brought an injunction restraining the city from expending further money on the plant. Unless new machinery is installed at once part of the city will be without street lights and there will be no power to operate the high-pressure pumps on the hill for fire protection. Dr. W. S. Vincent is chairman of the city light department.

CHASE CITY, VA.—The local electric-light and ice plants were destroyed by fire recently, causing a loss of about $25,000.

CHATHAM, VA.—The Town Council is reported to have awarded F. L. W. Bryant, of Thomasville, N. C., a franchise to install and operate an electric-light system in Chatham.

LEESBURG, VA.—The capital stock of the Leesburg Telephone Company is reported to have been increased from $10,000 to $25,000.

ABERDEEN, WASH.—Plans are being prepared by the Gray's Harbor Railway & Light Company for the construction of an electric railway from Cosmopolis to a point on Willapa Harbor. The company also proposes to make extensions to its systems in Aberdeen and at Hoquiam. H. B. Zimmerman is manager.

CHELAN, WASH.—The East Side Telephone Company is contemplating improvements and extensions to its local and suburban systems.

EVERETT, WASH.—It is reported that the Stone & Webster Engineering Corporation, of Boston, Mass., is contemplating a large hydroelectric development on the Sultan River. The dam, it is said, will be built across the canyon, about 17 miles east of Sultan. An electric railway, it is understood, will be built in connection with the power plant.

GARFIELD, WASH.—The Council has entered into a new contract with the Washington-Idaho Light & Power Company whereby a new street-lighting system will be installed. It is proposed to replace the arc lamps now in use with incandescent lamps and extend the street-lighting system in the residential portion of the town.

GOLDENVALE, WASH.—The Klickitat Irrigation & Power Company, of Seattle, Wash., has started work on its Horse Haven irrigation project, which will involve an expenditure of about $16,000,000 and will irrigate 300,000 acres of land in the Klickitat, Yakima and Benton County districts. L. M. Rice, Central Building, Seattle, Wash., is engineer.

LYLE, WASH.—The Superior Court has granted the Northwest Electric Company, of Portland, Ore., permission to condemn property for the right-of-way for its transmission line from its new power plant on the Klickitat River, now in course of construction.

PASCO, WASH.—Arrangements are being made to begin work on the construction of the new power station in Pasco. The first unit to be installed will cost about $80,000. James H. Moore, of Portland, Ore., is engineer in charge.

PROSSER, WASH.—The Pacific Power & Light Company is contemplating extending its transmission line into the Euclid and Byron districts. The proposed line will be extended from the substation at Prosser along the Euclid Road for about 6 miles west of the town, where it will be carried across the river to Byron, making in all about 7 miles of line. George D. Longmuir is local manager.

PUYALLUP, WASH.—The City Council, it is reported, will ask the Light Department of the city of Tacoma and the Tacoma Gas Company to submit bids for street lighting. The present contract will expire within the next twelve months, and it is proposed to call for bids soon so as to give prospective bidders ample time to make estimates, etc. The city pays the Pacific Coast Power Company $252 per month for the present service. The rate is $6 each per month for arc lamps, $1.25 each per month for 32-cp incandescent lamps and 75 cents each for lamps of 16 cp.

RINGOLD, WASH.—The Pacific Power & Light Company has closed a contract with the land owners of Ringold Bar to furnish electricity for irrigation and domestic purposes. The company will erect a high-tension line from the Prosser substation to Ringgold.

SEATTLE, WASH.—The electric-power plant of the Schwager & Nettleton Lumber Mill Company was recently destroyed by fire, causing a loss of about $25,000.

SEDRO-WOOLLEY, WASH.—The State Board of Control has extended the time for receiving bids for machinery for the new power plant at the Northern Hospital for the Insane from Nov. 6 to Nov. 30. Plans and specifications may be obtained at the office of Saunders & Lawton, Alaska Building, Seattle, Wash.

SPOKANE, WASH.—The Washington Water Power Company is contemplating the extension of its transmission lines to the North Hill district.

TACOMA, WASH.—The Board of County Commissioners is contemplating the installation of an electric tramway system at the Nisqually power plant at La Grande, the cost of which is estimated at about $18,000.

VANCOUVER, WASH.—Articles of incorporation are being prepared for filing for the Washington Trunk Railway by the General Development Company. The subsidiary company will be capitalized at $5,000,000 and will construct an electric railway from Vancouver to North Yakima and Ellensburgh. The building of an electric railway to Portland, Ore., is also contemplated. Lawrence Harmon is interested in the project.

PARKERSBURG, W. VA.—The contract for the construction of the power house at the government dam No. 19, below Parkersburg, has been awarded to the M. Laird Construction Company, of Philadelphia, Pa. The cost of the work will be about $40,000.

DE PERE, WIS.—The Green Bay Gas & Electric Company has applied to the City Council for a franchise to supply this city with gas.

MILWAUKEE, WIS.—The Council's street lights committee has recommended for adoption the resolution to purchase machinery for the proposed municipal electric-light system. As yet no provision has been made to erect a building or install wires.

SHULLSBURG, WIS.—The citizens have voted to grant the Interstate Light & Power Company, of Platteville, Wis., a franchise to construct and operate an electric-light system in Shullsburg. The company will extend its transmission line from the Hazel Green substation to this town.

SUPERIOR, WIS.—Arrangements have practically been completed by the Great Northern Power Company for the construction of a transformer station, to be located at Elmira Avenue and Twenty-eighth Street, into which wires of the new transmission line on the Wisconsin side of the river will run. The transmission line will extend from the power plant at Thompson to Superior. It is understood that the company has secured the right-of-way for the proposed line for the entire distance. The cost of the station and other improvements will be approximately $200,000

NIAGARA FALLS, ONT., CAN.—Extensive additions are being made to the power house and plant of the Ontario Power Company. The new building being added to the power house below Table Rock will give approximately from 100 ft. to 150 ft additional space to the plant, providing room for the installation of two units of 24,000 hp, which will increase the total output of the plant to 148,000 hp. The company, which has just completed the construction of a second pipe line, has obtained permission from the Queen Victoria Park Commission to add 150 ft. to its line to permit the development of an additional 24,000 hp.

SOUTHAMPTON, ONT., CAN.—Tenders will be received by Bowman & Conner, consulting engineers, Berlin, Ont., Can., for a small electric-driven pumping unit for the Southampton water-works system.

MOOSE JAW, SASK., CAN.—Tenders will be received by W. F. Heal, city clerk, Moose Jaw, Sask., Can., until Dec. 4 for supplying the fire department of the city with one pumping engine, with a capacity of 800 to 850 gal. per minute. Tenders are invited for motor-driven pumping engines, motor-propelled steam engines and horse-drawn steam pumping engines.

New Industrial Companies.

THE AEROCUTTA COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 for the purpose of manufacturing electrical machines, etc. The incorporators are: Samuel Lewis, Andrew Anderson, Jr., William A. Winter and Louis F. White.

THE BOWLES PHOTO & ENGRAVING LAMP COMPANY, of Evansville, Ind., has been incorporated with a capital stock of $50,000 by John C. Nutt, Emil Weil and William Gleichman. The company proposes to manufacture an electric lamp for photographic and other engraving work.

THE CENTRAL AUTO MANUFACTURING COMPANY, of Indiana Harbor, Ind., has been incorporated by Clifford C. Robinson, Francis E. Stephens and Boyd S. Gardiner. The company purposes to manufacture and deal in all kinds of automobiles, mechanical and electrical supplies. A plant will be established by the company to carry on its business.

THE CHICAGO MIXING & CONVEYING COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $10,000 to manufacture mixing and conveying machinery. The incorporators are: George Gillett, R. T. Elwell and Russell P. Fisher, of Chicago, Ill.

THE IDEAL POWER GENERATOR COMPANY, of Raymond, Cal., has been incorporated with a capital stock of $500,000 by G. A. Krohn, A. B. C. McGilvary, J. C. Krohn, J. W. Francis and E. M. Arreagada The company purposes to manufacture a tubeless boiler.

THE WILLIAM JACKSON COMPANY, INC., of Camden, N. J., has been incorporated by W F. Jackson, C. M. Morrison, of Philadelphia, Pa., and S. M. Roberts, of Camden, N. J. The company is capitalized at $125,000 and purposes to do a general mechanical engineering business.

THE KRUPP MOTORS COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $250,000. The incorporators are: D. Morgan, G. H. Anderson and J. McMorran, of Pittsburgh, Pa.

New Incorporations.

CEMENT, CAL.—The Cement, Tolenas & Tidewater Railroad Company has been incorporated with a capital stock of $500,000 to build an electric railway from Cement to Tidewater, a distance of 6 miles. The incorporators are: R. B. Henderson, A. D. Plaw, W. T. Barnett, Paul C. McCarthy and F. D. Madison, all of San Francisco, Cal.

LOS ANGELES, CAL.—Articles of incorporation have been filed for the International Lighting Company by G. Tufts, Jr., G. F. Zimmer and C. M. Taylor. The company is capitalized at $25,000.

MODESTO, CAL.—Articles of incorporation have been filed for the Modesto & Empire Traction Company by T. K. Beard, W. H. Frazine, J. M. Waithall and L. L. Dennett. The company is capitalized at $20,000 and purposes to build an electric railway from Modesto to Empire.

MANITOU, COL.—The Scenic Incline Railway Company has been incorporated by J. Frank Campbell, Oliver D. Dick and D. H. Rupp to build a cable railway to the top of Pike's Peak.

PAXTON, ILL.—The Consumers' Electric Company has been granted a charter to construct and operate an electric light, heat and power plant. The company is capitalized at $50,000. The incorporators are: H. A. Stevens, C. E. Bengston and C. A. Nordgren, all of Chicago, Ill.

Personal.

MR. FRED B. COREY, formerly engineer with the General Electric Company, has been appointed engineer in charge of the inspection department of the Union Switch & Signal Company, of Swissvale, Pa.

MR. D. R. SHEARER, associate member A.I.E.E., has been elected

general manager of the Acme Electric Company, of Knoxville, Tenn. This company does a general contracting, supply and engineering business.

MR. HOMER E. NIESZ, president of the Electric Club of Chicago, addressed the Electrical League of Cleveland on Nov. 3, extending greetings in the exchange of courtesies which has distinguished these two organizations.

MR. L. F. HOWARD, who has been electrical engineer of the Union Switch & Signal Company, of Swissvale, Pa., has been appointed engineering manager of that company, succeeding Mr. J. P. Coleman, formerly chief engineer and now retained as consulting engineer.

MR. WILLIAM G. WALKER, who was formerly with the Philadelphia Electric Company and with the Leeds & Northrup Company, Philadelphia, and more recently with Machado & Roller, New York, has accepted a position with the New York Edison Company and assumed charge of its standardizing laboratory.

MR. ARTHUR BESSEY SMITH, formerly professor of telephone engineering at Purdue University, and now with the Automatic Telephone Company, Chicago, spoke before the noon luncheon meeting of the Purdue Association of Chicago, on Nov. 9, on the subject of "Human Accuracy vs. Mechanical Reliability."

MR. H. THURSTON OWENS, consulting engineer, New York City, has been invited to lecture before the Empire State Gas & Electric Association on Nov. 22, at Syracuse, N. Y. Mr. Owens will describe the various public lighting installations of note in this country and Europe, illustrating them by stereopticon views.

MR. F. C. CHAMBERS has resigned his positions as chief engineer for the Springfield (Ill.) Light, Heat & Power Company and engineer of power stations for the Springfield Consolidated Railway Company, and will be associated on railway-franchise work with Mr. Emil G. Schmidt, formerly vice-president and general manager of the last-mentioned company.

MR. R. W. WHITEHEAD has been made division plant superintendent of the Western Union Telegraph Company, with headquarters in Chicago. Mr. Whitehead, who was born in New York City in 1872, is a graduate of Yale University and the Sheffield Scientific School. He has been connected with the engineering departments of a number of telephone companies and was more recently division plant superintendent of the Western Union Company at Denver.

MR. WILLIAM J. HAGENAH, of Chicago, has been engaged to prepare the testimony of the Union Electric Light & Power Company, of St. Louis, in the rate case which is now pending before the Circuit Court of St. Louis County. An injunction was secured recently by the company restraining the city of St. Louis from enforcing the rate schedule based on the maximum rate fixed by the Public Service Commission. In the preparation of the case Mr. Hagenah is making a valuation of the property of the company and a complete audit of the accounts. The case will probably not be called for a hearing for several months.

MR. K. H. HANSEN has been appointed chief electrical engineer and superintendent of distribution of the Union Electric Light & Power Company, of St. Louis, succeeding Mr. S. B. Way, who resigned to take charge of the electrical department of The Milwaukee Electric Railway & Light Company. Mr. Hansen was graduated from the University of Missouri at Columbia City, Mo., in 1898, with the degree of B. S. in E. E. Following graduation he was connected with the former Missouri-Edison Company, the Laclede Power Company, and finally the Union Electric Light & Power Company, where he has been assistant electrical engineer in active charge of much of the work of the electrical department for several years.

MR. L. D. MATHES, manager of the Union Electric Company, of Dubuque, Ia., has resigned to become general manager of the Citizens' Light, Heat & Power Company and the Montgomery Traction Company, of Montgomery, Ala. Mr. Mathes is one of the best known of the central-station managers of the Central West, and many friends in Iowa and Illinois will view his departure with regret while congratulating the Montgomery companies on a strong acquisition. He is a former president of both the Iowa Electrical Association and the Iowa Street & Interurban Railway Association, and he is a well-known figure at the national gathering of electric-light and street-railway men. Mr. Mathes has had a wide and varied public-utility experience, and he made a fine record in Dubuque, where he had charge of a combined electric-service and street-railway property. His work in Montgomery will begin on Dec. 1.

Obituary.

MR. EDGAR WOOD MIX, well known in electrical engineering circles from his connection with the early Thomson-Houston Electric Company, was drowned in the English Channel on the night of Nov. 12. The conditions surrounding his death are unknown, as he was alone when he disappeared from a Channel steamer. Mr. Mix was born near Columbus, Ohio, Feb. 4, 1867. He graduated from the Ohio State University with the degree of B. S., in 1888. In August of that year he entered the employ of the Thomson-Houston Electric Company in the department devoted to the manufacture of watt-hour meters. In 1890 he went to Paris in connection with a watt-hour meter contest and established there a factory for building watt-hour meters for the Thomson-Houston International Electric Company. He occupied the position of chief engineer of this firm until the first of the present month, when he resigned to become manager of the European division of the General Motors & Export Company, of Detroit. Mr. Mix was elected an associate of the A. I. E. E. in 1889 and transferred to the grade of member in 1895. In recent years he had been much interested in aeronautics, and he was a member of both the Aero Club of France and the Aero Club of America. On Oct. 5, 1909, he won the international balloon race at Zurich, Switzerland, and he had been chosen delegate to the international aviation conference which will open in Rome on Nov. 25, 1911. Mr. Mix was unmarried.

Trade Publications.

INCANDESCENT LAMPS.—The engineering department of the National Electric Lamp Association has issued Bulletin 8-C on "Miniature Carbon Lamps" and 12-A on "The Electric Lighting of Automobiles." These bulletins are revised editions of former publications on the same subjects.

PLUNGER PUMPS.—Bulletin No. 101 of the Goulds Manufacturing Company, Seneca Falls, N. Y., contains much information concerning the constructive details and operating characteristics of single-acting, triplex plunger pumps. These pumps are designed for work under pressures varying from 130 lb to 200 lb per square inch.

BRUSH TESTING.—The National Carbon Company, Cleveland, Ohio, has issued an instructive booklet relating to the testing of brushes on electrical machines. The book contains an outline of a standard method of making tests, and brief descriptions of the rigid inspection and thorough test to which the brushes are subjected subsequent to manufacture and before they are shipped.

DIRECT-CURRENT MACHINERY.—Bulletin No. 1011 issued by the Ideal Electric & Manufacturing Company, Mansfield, Ohio, contains a complete discussion of the details of construction and operation of direct-current motors and generators. Test curves of this type of motor and generator are included, and some of the details of construction are illustrated by special drawings.

BUSINESS NOTES.

THE INDEPENDENT ELECTRIC MANUFACTURING COMPANY, of Milwaukee, has appointed the Lamb Electric Company, of Grand Rapids, as its agent in that city. A complete line of motor starters and controllers will be carried at the Grand Rapids agency.

THE WHEELER CONDENSER & ENGINEERING COMPANY.—Mr. George F. Pond has been appointed manager of the Philadelphia territory for the Wheeler Condenser & Engineering Company, and Mr. Walter G. Stephan has been made manager of the Cleveland territory for this company.

THE CONTINENTAL CAR & EQUIPMENT COMPANY, of Highland Park, Ky., near Louisville, has begun the manufacture of electric commercial trucks. Plans have been matured for building these vehicles in 5-ton, 3½-ton, 2-ton, 1-ton and 1000-lb. sizes. Mr. McKinley Boyle, of New York, is president of the company and Mr. A. B. McKinley is vice-president and general manager.

THE ELECTRIC STORAGE BATTERY COMPANY.—The sixth convention of the engineering staff and sales department of the Electric Storage Battery Company was held in Philadelphia on Nov. 6, 7, 8, 9 and 10. This convention was attended by the managers and salesmen from offices in Philadelphia, New York, Chicago, Boston, Cleveland, St. Louis, Denver, Detroit, Atlanta and San Francisco.

THE TRIUMPH ELECTRIC COMPANY.—The following is a partial list of recent sales reported by the Triumph Electric Company, Cincinnati, Ohio: Sixteen generators aggregating 1650 kw; one 35-kw turbo-alternator; one 100-kw motor-generator set; 135 motors aggregating 2175 hp, and 35 transformers of various sizes. The new line of Triumph alternating-current generators and transformers recently placed on the market are reported to be much in demand.

PANAMA CANAL CABLE.—At the recent convention of the Association of Railway Electrical Engineers in Chicago the Kerite Insulated Wire & Cable Company displayed a piece of the cable manufactured for the Panama Canal. This is a four-conductor submarine cable, 50 miles long, connecting Colon and Panama. It was put into service three years ago, lying partly on the ground and partly underground, but as the work is completed the cable will be placed in the canal itself.

TREATING CEDAR POLES.—The Lindsley Brothers Company, of Spokane, Wash., specialist in Idaho poles, has just installed a treating plant at its Priest River (Idaho) yard for the treating of poles with avenarius carbolineum by the open-tank process. The plant has a capacity of 300 poles a day, and the company has just completed the shipment of a large order of treated poles from this plant to Colorado points. This plant makes the second one operated by the Lindsley

Brothers Company, which has a very complete pole, tie, timber and paving-block plant located in Spokane. It has recently completed the treatment of 40,000 ties for the Washington Water Power Company and has a number of contracts on file for spring delivery.

MOORE TUBES FOR COLOR MATCHING.—Shipments of complete factory built units of the white Moore tubes to textile and dyeing establishments for color matching have been made recently to the following: Bradford Dyers' Association, Bradford, Eng.; Belding Paul Cortice'li, Ltd., Montreal, Can.; Dunn Worsted Mills,, Woonsocket, R. I.; the Felters Company, Millsbury, Mass.; Conshohocken Dye & Finishing Works, Philadelphia; Hind & Harrison Plush Company, Clark Mills, N. Y., and to the Glenlyon Dye Works, Saylesville, R. I. The company states that demand for the white light is broadening in a very gratifying manner, due to its color-distinguishing advantages and to the adaptability of the self-contained factory-exhausted types for express shipment.

THE AMERICAN SHIP WINDLASS COMPANY, builder of the Taylor stoker and marine equipment, is moving its factory from Providence, R. I., to Philadelphia, where the company already had a large plant. A large foundry has also recently been erected in Philadelphia. This company was established fifty-four years ago by Messrs. Frank S. and Joseph Manton, who had much to do with the invention of the ship windlass. From the manufacture of the ship windlass the company branched out and added marine machinery, and in 1905 began the manufacture of the automatic stoker invented by Mr. E. E. Taylor, of Boston. This stoker, which is of the underfeed type with an inclined fuel bed, is extensively used in boiler plants requiring a large output in a small space, and in cases where it is necessary to burn soft coal without smoke.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 7, 1911.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,007,671. SAFETY SIGNAL FOR VEHICLES; G. F. Buente and H. C. Fling, New York, N. Y., and Spring Lake, N. J. App. filed Feb. 11, 1909. Electric tail-lights for automobiles to indicate change of course and speed.

1,007,674. ARC LAMP; K. Cosiolkofsky, Vaals, Netherlands. App. filed Aug. 13, 1908. Inclosed arc.

1,007,683. PROCESS OF FORMING OXIDS OF NITROGEN; C. Ellis, Montclair, N. J. App. filed July 29, 1911. Air is passed concentrically but not helically about an arc.

1,008,002.—Carbon Electrode.

1,007,684. TELEPHONE-RINGING DEVICE; H. N. Faris, Kansas City, Kan. App filed Feb. 13, 1909. Galvanic battery and an inductive transformer for energy.

1,007,694. VAPOR CONVERTER; P. C. Hewitt, Ringwood Manor, N. J. App. filed March 20, 1908. Hollow metallic electrodes.

1,007,705. ELECTRIC BRAKE FOR ELECTRIC MOTORS; M. Kallmann, Berlin, Germany. App. filed April 23, 1907. Variation resistance is heated to incandescence.

1,007,741. LINE-JOINT TESTER; H. H. Simpson, Pilot Grove, Mo. App. filed Oct. 24, 1910. A number of contacts on one handle for testing telephone and telegraph lines.

1,007,770. LIGHTNING ARRESTER; W. E. Butler, David City, Neb. App. filed Sept. 23, 1910. Mercury electrodes in a vacuum chamber.

1,007,791. LAMP SOCKET; Morey & Brogden, Syracuse, N. Y. App. filed July 9, 1909. Pull switch with inclines and a ratchet member.

1,007,802. SWITCH BOX; C. N. Sachs, Hartford, Conn. App. filed Aug. 31, 1905. The box cover constitutes the switch arm.

1,007,869. ELECTRODE FOR FLAMING-ARC LAMPS; C. W. Hill, Lakewood, Ohio. App. filed Sept. 21, 1910. Different color-producing elements are incorporated in the electrode.

1,007,876. EXPLOSION-PROOF CARTRIDGE CUT-OUT; W. Klement, Neu-Finkenkrug-Falkenhain, Germany. App. filed Aug. 5, 1910. Fusible elements of different lengths.

1,007,883. TELEPHONE TRANSMITTER; C. T. Mason, Sumter, S. C. App. filed July 5, 1910. Insulation features for the diaphragm.

1,007,886. ELECTRO-MECHANICAL SWITCHING DEVICE; R. R. Miller, Pueblo, Col. App. filed Dec. 13, 1909. Trolley-controlled railroad switch.

1,007,893. COMMUTATOR SHORT-CIRCUITING DEVICE; C. S. Reno, Cincinnati, Ohio. App. filed Nov. 5, 1909. Centrifugal devices for short-circuiting.

1,007,897. ELECTROLYTIC APPARATUS; G. O. Seward and F. Von Kügelgen, Holcomb's Rock, Va. App. filed April 23, 1906. An annular chilled salt-incrusted partition surrounding the cathode in a sodium-reduction process.

1,007,902. COMMUTATOR SHORT-CIRCUITING DEVICE; L. H. Thullen, Cincinnati, Ohio. App. filed April 1, 1910. Centrifugally operated tumblers.

1,007,948. SWITCH; B. Haskins, Milwaukee, Wis. App. filed April 27, 1910. Single-break rotary double-throw oil switch.

1,007,990. METHOD OR PROCESS FOR THE REDUCTION AND SMELTING OF ORE AND ARRANGEMENT THEREFOR; F. Tharaldsen, Trondhjem, Norway. App. filed May 31, 1911. Ore is fed into the top and the reducing agent is fed in lower down to protect the electrodes and the furnace lining.

1,007,998. ELECTRIC SWITCH MECHANISM; H. F. Whalton, Key West, Fla. App. filed Jan. 12, 1911. A cup with mercury and contacts to control solenoids for actuating steering vanes of aeroplanes, etc.

1,008,000. RHEOSTAT; G. H. Whittingham, Baltimore, Md. App. filed March 19, 1909. The hand-operated arm has a lock and key.

1,008,002. CARBON ELECTRODE; M. W. Allen, Lakewood, Ohio. App. filed Sept. 12, 1910. Sectional carbons with graphite inset blocks and threaded graphite dowels.

1,008,012 MANHOLE SWITCH; S. B. Condit, Jr., and A. E. Greene, Boston, Mass. App. filed May 14, 1909. Water-tight oil switch.

1,008,030. CAR-TRUCK CONSTRUCTION FOR ELECTRIC RAILWAY SIGNAL SYSTEMS; G. B. Gray, Pittsburgh, Pa. App. filed July 16, 1909. Insulation of the parts for a signal system like Patent No. 909,083.

1,008,087. INSULATOR; J. M. Sweeney, Howell, Fla. App. filed July 17, 1911. A porcelain cleat for holding telephone wires, etc.

1,008,122. TELEPHONE CASING; W. W. Dean, Elyria, Ohio App. filed June 8, 1910. The metallic cap and insulating member are secured together.

1,008,172. AUTOMATIC SIGNALING SYSTEM; D. J. McCarthy, Wilkinsburg, Pa. App. filed March 5, 1910. Alternating-current railway system for three-position signals.

1,008,189. BRAKING APPARATUS; A. Sundh, Yonkers, N. Y. App. filed Sept. 23, 1905. Elevator driven by an alternating-current motor and a direct-current generator acts as a brake. (Forty claims.)

1,008,216 PARTY-LINE TELEPHONE SYSTEM; E. Stout and J. S. Kupka, Martinsburg, Ia. App. filed July 19, 1910. Lockout mechanism; interparty busy signals.

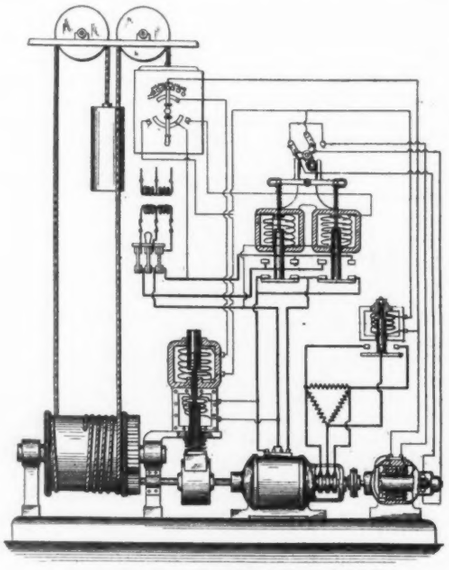
1,008,232. TELEPHONE TRUNKING SYSTEM; C. S. Winston, Chicago, Ill. App. filed Dec. 4, 1907. A disconnect signal to central even when the subscriber immediately tries to get a second call.

1,008,243. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed Nov. 21, 1910. A voltage coil and a current coil and automatic means for determining which shall regulate the generator of a storage-battery generator car-lighting system.

1,008,244. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed June 21, 1911. Car-lighting system with automatic regulation.

1,008,270. REACTANCE COIL; W. O. Jacobi and C. Harris, Chicago, Ill. App. filed May 4, 1908. To give a steady arc in hand-fed alternating-current lamps

1,008,282. SELECTIVE TELEPHONE SIGNALING SYSTEM; C. H. North, Cleveland, Ohio. App. filed Oct. 11, 1907. Alternating currents of non-interfering frequencies such as 30, 42 and 54 cycles.



1,008,189.—Braking Apparatus.

1,008,287. ACETYLENE-GAS LIGHTER; H. Van Hoevenberg, Lake Placid Club, N. Y. App. filed March 22, 1910. Movable sparking contacts.

1,008,293 TRANSFORMER SYSTEM; H. C. Caldwell, Fort Mills, Corregidor, Philippine Islands. App. filed Sept. 9, 1910. A controller for shifting from one unit to another.

1,008,294. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed Nov. 21, 1910. Car lighting by storage battery and generator.

13,307 (Reissue). PROCESS OF RECOVERING FINE GOLD; J. H. Alling, Columbia, Cal. App. filed Feb. 1, 1910. The ore is mixed with a chlorine compound and electrolyzed so that nascent chlorine is set free to attack the gold. Original Patent No. 947,957.